# Final report

**Technical and economic feasibility study of potential renewable energy generation projects in Temple Guiting parish**

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# 1 High level summary and recommendations

**In brief**
Temple Guiting Community Energy (TGCE) has a realistic opportunity to develop a modest-scale investable PV project at the Cotswold Farm Park. Generally it would be advised to start small before scaling up, but a combination of regulatory, infrastructure and geographic factors means it will be hard to achieve small scale projects within the village in the short term. TGCE will need to create a dedicated team with a good balance of skills, and focus most of its effort from now until mid-late 2017 on building a partnership with the Farm Park to install 50kW of PV on a new-build barn roof, launching the Community Benefit Society, and raising around £50k from local investors who will be members of the Society. This will create a platform from which other project opportunities and related initiatives can be launched in the future.

**Build a team with the skills and commitment to pursue projects over the medium term**
Success will depend on the group assembling a small team, who can become officers of the community energy company once formed, with a good balance of skills, including finance / accounting, contract / commercial and project management. The team will need access to external technical / commercial support, and must be able to maintain motivation and focus over the medium term. It will be important for the team to collaborate and share resources with other similar community energy initiatives, or commercial partners with specific skills or resources. It will also be important, considering that all effort will be voluntary, that the team uses its probably limited time to best effect, and focuses most of its effort on the Farm Park PV.

**Focus most effort on Farm Park PV**
The main focus of the team should be on a 50kW roof-mounted PV installation in collaboration with the Cotswold Farm Park, with a timeframe driven by the Farm Park's own development of new buildings (due for completion during 2017). This is the project with the best chance of success, which can provide an 'anchor' for future investment projects or other initiatives. TGCE should assemble a small project team to work closely with the Farm Park business and its landlord, aiming for PV installation at the same time as the new barn is built. This will in turn dictate the time-line for creation of the community energy company and launching the fundraise, and is likely to require some focused effort before the end of this year.

**Pursue wind on Pinnock Hill over the longer term**
The team should also pursue, but as a second order priority only, a single wind turbine project on Pinnock Hill, of around 50kW. The team will need to appreciate that eventual success with planning permission and achieving a strong economic performance are not guaranteed, and should even be viewed, at this early stage, as improbable. However, if very strong local support can be generated, and a creative commercial approach taken, then the project would have the potential to generate, in the long run, more energy and revenue than the Farm Park PV. It will be essential to pursue a risk- and cost-minimising strategy for the development process, and not to commit significant resources to the project (eg planning application) unless every aspect of viability can be shown to be positive.

**Further explore PV on the church and school over the longer term**
The project has established that PV installations in both the church and school are, at first glance, problematic. This is due to: The church being grade 1 listed, the historic church roof being unsuited to additional panel weight; the small size of the potential church installation and restrictions on ground-mounting panels in the church grounds; the relatively low self-consumption of power by both the school and church; the unsuitability of the school roof (steep pitches, stone tiles); the lack of load-bearing ability in the roofs of buildings surrounding the school; the lack of suitable space for ground-mounting panels in the school grounds; the restriction on grid capacity

for the circuit that serves the school and church, meaning that only domestic-scale installations (G83, 4kW) could be accommodated. Nonetheless this feasibility study assesses project conditions only at a high-level, and it may be possible to work-round some of these barriers with a determined approach that looks at each issue in more detail. TGCE should therefore, as a second order priority only, continue to explore the church and school PV opportunities, perhaps starting by inviting PV contractors to provide their opinions on viability. The school and church opportunities should however not be pursued if it risks reducing effort on the Farm Park opportunity.

**Maintain contact with the quarry PV opportunity for the future**

The Huntsmans Quarry ground-mounted PV project is, at this moment, not viable due to grid connection constraint, and associated cost. However the team should regularly review the project conditions and keep in touch with the quarry management team in order to update the economic model, taking account of both the quarry's own future investment in grid connection capacity, the falling cost of PV installations, falling cost of storage and the emergence of more sophisticated business models tying together grid storage, PV and the deferment of grid upgrade costs.

**Maintain a watching brief on domestic scale battery storage**

TGCE has expressed interest in electricity storage and innovation in general. Whilst there does not appear to be a simple economic case for domestic-scale battery storage at present (costs are falling but simple payback periods appear still to be well in excess of the lifetime of the batteries), either for time-shifting cheaper overnight tariffs or for storing PV generation, the team should regularly review the market, which is in rapid transition. It is likely that within two or three years, the cost of domestic scale storage may have fallen to the point where the community energy company could aggregate together many properties in the village and create a genuinely $CO_2$-saving and cost-saving proposition.

**Look for opportunities for village-scale storage trials**

Research and commercial trials centred on electricity storage will continue to be important in the next few years, given the worldwide focus on this technology and the rapid evolution of new technology and regulation / policy governing this growing area. Therefore it is possible that TGCE could actively promote the village as a potential trial site, considering its particular grid characteristic (ie, a rural location with weak and inflexible electricity grid), either for storage installations in individual households, or even for experiments at the level of the whole village. Such trials, whilst only obliquely supporting renewable electricity generation, may be capable of generating revenue and thereby strengthening the community energy company.

**Explore innovative electricity supply arrangements**

A further whole-village, or multiple-household, initiative that only obliquely supports renewable generation, is for TGCE to broker group switching to a new electricity supplier, in such a way that TGCE receives a payment for each customer that switches, and a further loyalty payment for each year that the customer stays with the supplier. Whilst switching payments are unlikely to be large (of the order of £20-£30 per customer per year), it would have the potential to create modest momentum and revenue for TGCE, a modest contribution to the community fund, provide a focus for villagers to engage with the company (and save money on energy bills, depending on their current supply arrangements), potentially create a link to generation projects such as Farm Park PV, and also provide a focus for village engagement in initiatives to save energy / $CO_2$.

**Engage village residents in an information-sharing group to pursue domestic-scale renewables.**

We have established that undertaking a coordinated, simultaneous multiple-household installation of PV systems through a single contractor (which would have carried some cost reduction benefit and might have been appropriate for TGCE financing through a community fundraise) will not be possible for reasons of limited grid capacity within the village boundary. Nonetheless, due to a quirk of the FIT regulations, individual householders could still install PV systems up to 4kW capacity without prior permission from the electricity distribution company, Western Power

Distribution (WPD). It is clear from discussions in previous meetings that village residents have an interest not just in PV but in other domestic-scale low-carbon and renewable energy options for heat and electricity, as well as interest in energy saving. TGCE could create a 'self-help' group for such residents to compare notes and build commitment, which could also provide a platform for later community fundraises for the Farm Park PV.

**Do not pursue pico hydro in Guiting wood**
The proposed run of river pico hydro scheme on the eastern edge of Guiting Wood appears non-viable due to its size and location. Such a scheme, if installed, would have a maximum installed capacity of around 1 or 2$kW_e$ and a likely gross financial yield of around £1000 per year, not taking account of maintenance or financing charges. Considering the likely installation cost, and the possibility that the Environment Agency would not permit the entire flow to be used for hydro, the length of time typically required (often many years) for hydro scheme permitting, and the high risk of cost overrun it is extremely unlikely that the scheme could pay back within its lifetime. It is recommended that the TGCE team drops this project.

# 2 Community Engagement

## 2.1 Extent of local support for the project(s).

Gauging the depth and breadth of support for the project must take account of the nascent nature of the community energy company and its investment plans. Had the local group been at a more advanced stage (eg already having created a distinct identity by forming a community company, appointing directors, creating a name and 'brand', and specifying in detail the investment opportunity/ies) then local support for, or objection to, specific plans could be tested more directly.

In the absence of such advanced plans, there is nonetheless evidence of sustained support within the village for the principle of a community-owned and controlled energy company, and a good level of debate around the potential for extending the remit of such a company in the future, potentially moving beyond raising investment for renewable electricity generation technologies, towards energy efficiency or renewable heat initiatives.

The Parish Council has supported the idea of a community energy company in general, and supported further action (this feasibility study). Initial steps were taken to stimulate interest in the idea some three years ago. Wider meetings to discuss the proposed community energy company have been locally advertised and well attended, over a period of some 18 months or 2 years, attracting typically 15-40 attendees, out of a village population of (an approximate estimate) 180.

There is no obvious evidence of objection to the principle of forming a community energy company, but it should be noted that reservations were expressed by some about the likelihood of success of, and the inherent attractiveness of, a wind power proposal in the vicinity of the village.

## 2.2 Number of committed supporters

It is too early in the planning of the community energy company to gauge local interest in, or commitment to, investing. No firm details are available of an investment proposal, its capital requirement or target interest rate. Therefore the appetite of villagers to purchase shares has not been tested directly.

Interest has been expressed in principle in the idea of purchasing energy generated by locally owned assets, but it is acknowledged that the mechanism by which this can be achieved is uncertain.

## 2.3 Objections raised

No strong objections have been recorded. At this point in time discussions have been largely confined to the village of Temple Guiting, and very few residents of neighbouring villages or elsewhere in the Parish have been involved.

## 2.4 Key stakeholders

Key stakeholders are as follows:

**Cotswold Farm Park.** The Farm Park has advanced plans to develop new visitor buildings, and plans for these developments are now approved, which include up to 50kW of roof-mounted solar. Completion of this build phase is expected for 2017, and the community expects to be able to reach agreement with the Farm Park to raise funds for the solar PV installation. The Farm Park is naturally incentivised to collaborate with the community energy company because 1) it needs to preserve its own (or borrowed) capital to focus on its key business objectives, 2) it will benefit from reduced electricity cost, and 3) it is in the business's interest to maintain a good relationship with the village since the village may be negatively impacted to some extent by the Farm Park's in creased activity (traffic), and positively impacted (employment opportunities).

**Dawsonrentals Truck & Trailer Ltd.** Dawsonrentals is the landowner for the Farm Park, and must be fully in agreement with and committed to the PV project in order for it to progress. The company is provisionally supportive of the idea, but has raised quite natural concerns about long-term risk management, and will want to see evidence of a solid business plan for TGCE that addresses any risks and demonstrates that TGCE is a solid counterparty to any roof lease required for the PV panels at the Farm Park.

**Church.** The church has expressed interest in having solar PV panels sited either on or adjacent to the church. Whilst the roof structure appears not to lend itself to PV panels, and the electrical connection capacity is very limited, the church may be an important element in the formation and maintenance of the community energy company, and may be a beneficiary of any community funds generated through project returns.

**Guiting Manor Amenity Trust.** The Trust owns and farms land around the adjacent village, Guiting Power, including the land on which the potential hydro power scheme would be sited. Whilst we are recommending that TGCE does not pursue the hydro power project, the Trust appears to have been provisionally supportive of the idea, and also has some experience of barn-mounted PV. The Trust, which has won awards for its wildlife protection initiatives, may be a good local partner for widening future participation in the community energy company, and may be in a position to identify future renewables investment opportunities on land close to Temple Guiting.

**Severn Trent Water.** Severn Trent Water owns the pumping station close to the potential hydro power site, and is broadly supportive of the community energy company's ambitions to build a hydro scheme. Whilst we are recommending that the hydro project is not pursued, Severn Trent may nonetheless be an important stakeholder if the Pinnock Hill wind project progresses, since one option for connection of the wind turbine is at the pumping station. Severn Trent has indicated that it would be willing to facilitate the connection of a renewable power scheme, but notes that the pumping station is currently not being used, and therefore there is no immediate financial benefit from use of power for pumping purposes.

**School.** The head teacher of the village school has expressed an interest in either having solar PV panels on the school roof, or else ground mounted if this could be achieved in a way that minimized any area lost for other amenity uses. The school would be keen to use any solar panels to both reduce energy cost for the school, and provide a teaching resource for the children. The school could also be an eventual beneficiary of any funding through the community fund. We have recommended that the school PV scheme be pursued as a second order priority only.

**Quarry.** Huntsmans Quarry was, at the outset of this feasibility study, assumed to be a strong prospect for a PV generation site. Subsequent dialogue with WPD has shown the cost of connection to be prohibitive, meaning the PV project is not currently viable. Nonetheless the quarry management was supportive of the proposal, and TGCE should keep in touch with the quarry to see if new opportunities arise.

**Individual home owners.** Individual householders in the village are crucial stakeholders. Whilst it appears difficult for TGCE to undertake a multi-home PV installation in the village, clearly villagers are the backbone of TGCE and provide its impetus. Communication with villagers seems strong and effective at present.

# 3 Community Benefits

## 3.1 Type and scale of potential community benefits

The Temple Guiting community energy investment opportunities are small, relative to many community energy investments, and will require phasing over a period of time. Small scale investments will always be less cost-effective than larger schemes, due to typical legal and financing costs being largely fixed, and therefore impacting returns disproportionately compared to larger investments. Financial community benefits will therefore be correspondingly small, and are likely to be realized later in the project lifecycle.

The main project with good likelihood of success is PV on Cotswolds Farm Park, which has the potential to generate some £6k over the 25 year project life.

Due largely to the (likely) very small scale of community financial benefits generated, little attention has been paid at this stage to the potential application of community funds generated.

Given that financial benefits in the form of a community fund are likely to be very small, at least until a more substantial sized project can be developed, the key community benefits will come from the creation of the community energy company itself, and will manifest in the form of greater community cohesion, sharing of information and ideas in respect of energy efficiency and domestic-scale renewable generation technologies. Temple Guiting clearly has significant community spirit, which initiatives like the community energy company will reinforce.

## 3.2 Number of people benefitting

With such small financial benefit created for the community fund, at least until additional projects can be implemented, the number of people benefitting is likely to be small. The group has not yet considered best use of community funds, but it is likely that a low cost but village-wide initiative would be proposed (perhaps focused on energy efficiency improvement). In this case potentially all 61 households could benefit.

## 3.3 Local jobs created

The scale of project investment means that no additional local employment is likely to be created. However, local tasks related to the Farm Park PV (such as system checks, meter reads etc) will be required and may be carried out either on a voluntary basis by TGCE members or by existing staff at the Farm Park.

# 4 Technologies considered

The technologies under consideration at the outset of the feasibility study were small scale run-of-river hydro, small scale wind, anaerobic digestion of farm waste, building mounted and ground-mounted PV.

To best present the individual projects and to make this feasibility report logically readable, each potential project has been given a separate section, and within each project section the issues of technology, financial projection, fundraising, planning and permitting, site, operations and scheduling are covered. Project sections are of varying length, reflecting the depth of enquiry and prospects for each, and for the sake of completeness all projects are covered, whether or not we recommend their continuation.

Anaerobic digestion of farm waste was quickly dismissed because of the lack of slurry at the farm park.

Sections 6-12 therefore cover the following projects:

- 50kW building-mounted PV at the Cotswold Farm Park
- 50kW wind turbine on Pinnock Hill
- Ground mounted PV at Huntsmans Quarry
- Individual household PV within the village
- Electricity storage in domestic-scale batteries
- Roof- or ground-mounted PV on the church and school
- Small scale hydro

Of these, the best prospect for short-medium term success is the PV at the Farm Park, and we recommend that the TGCE team should focus purely on that project in the short term.

# 5 50kW roof-mounted solar PV at Cotswold Farm Park

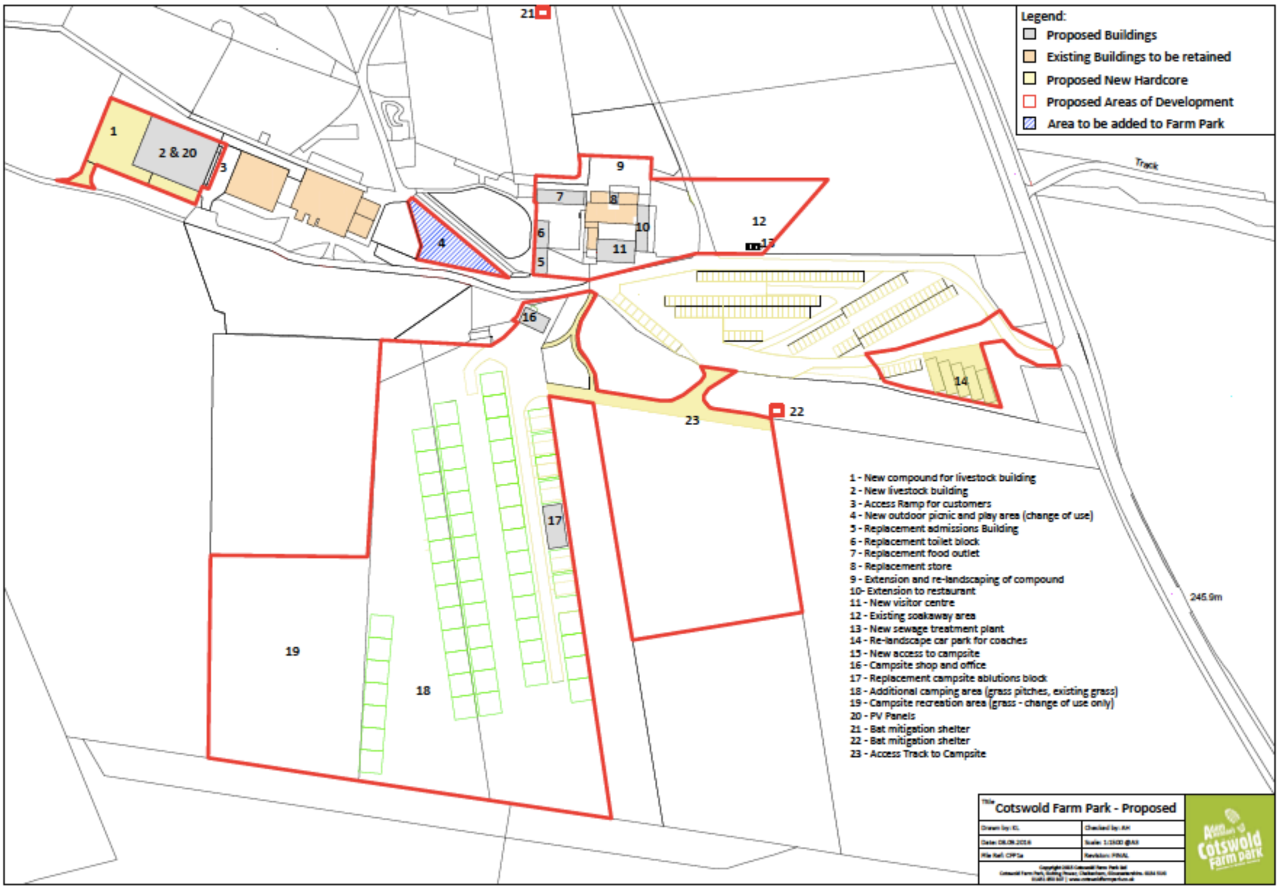
## 5.1 Summary

This is the most viable of all project opportunities assessed here, with a potential investment size of £50k, project IRR of around 6% and community fund value of £6k. There are strong reasons why the project should succeed, but as with any project at this relatively early stage there are also unknowns and potential barriers. It should be a priority for TGCE to form a working group and focus all its available resources on this project.

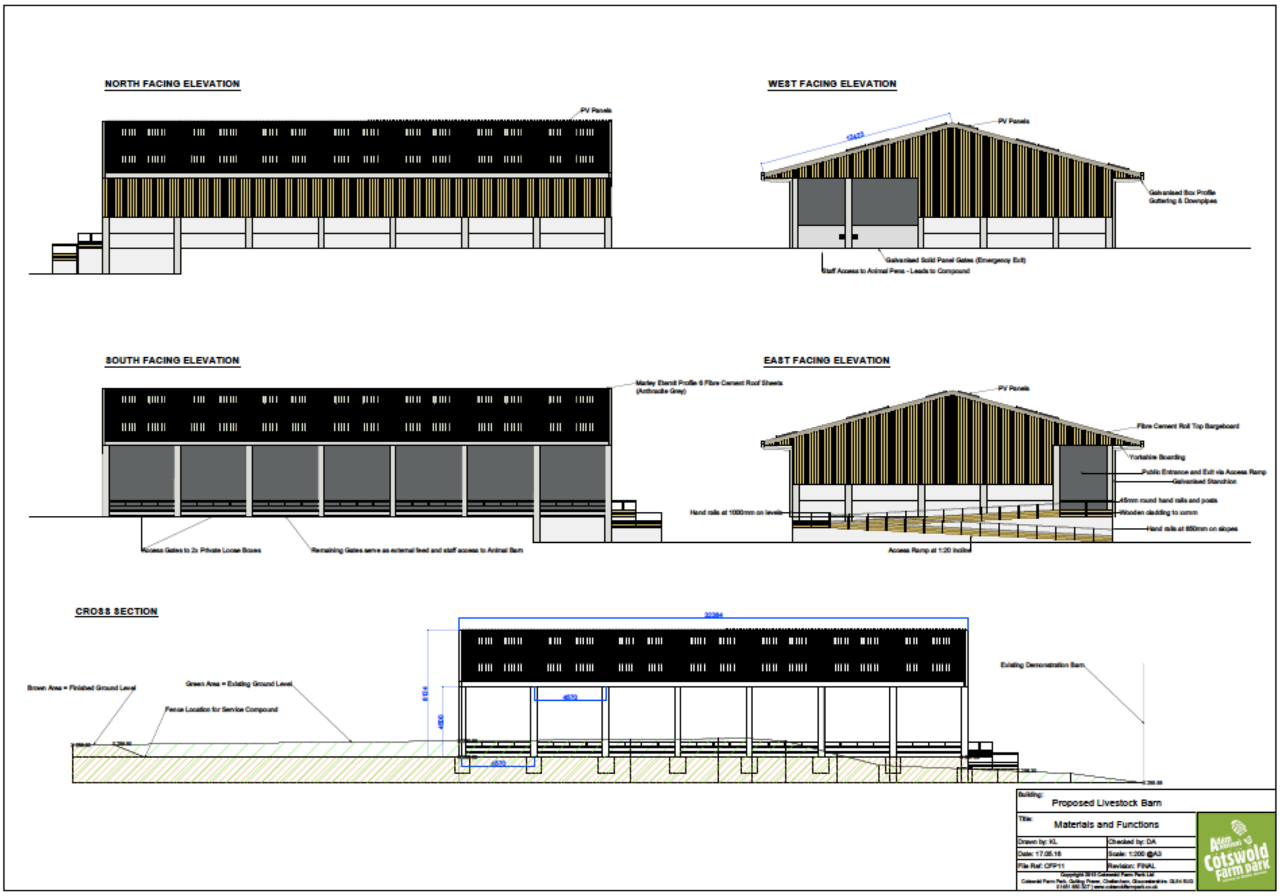
## 5.2 Technology

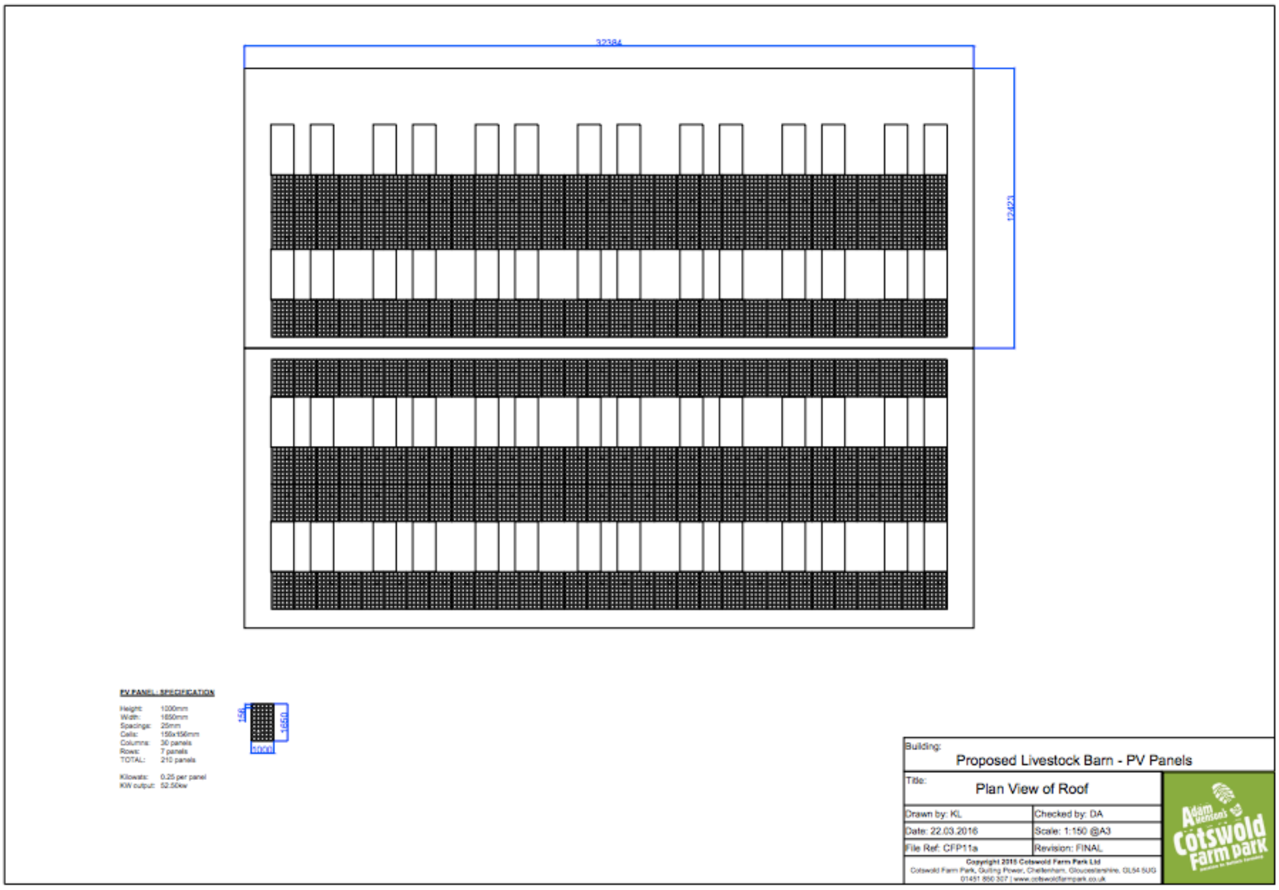
To illustrate a complete, community-funded, roof-mounted 50kW PV project, the picture below is of the PV array installed on a supporters' stand at Frome Town Football club, by Frome Renewable Energy Co-op (FRECo). Live PV performance may be viewed at: https://www.solarweb.com/PvSystems/PvSystem?pvSystemId=715f7ec6-3fd7-4202-9e5b-a5bf00b212ab.


Cotswold Farm Park has been granted planning permission for new visitor buildings as part of its business expansion. The permission (Cotswold District Planning Authority reference 16/02375/FUL) includes PV panels on a new livestock building (top LH corner of the site plan below, marked "2 & 20").




The proposed livestock barn that has been approved shows some 50kW of PV panels arranged on both the southern and northern pitches of a corrugated fibre cement clad, symmetric 15 degree (approximate) pitched roof on a standard single bay steel portal frame barn, with panels placed between skylights (see below):


NORTH FACING ELEVATION
PV Panels
WEST FACING ELEVATION
12423
PV Panels
Galvanised Box Profile Guttering & Downpipes
Galvanised Solid Panel Gates (Emergency Exit)
Staff Access to Animal Pens - Leads to Compound
SOUTH FACING ELEVATION
Marley Eternit Profile 6 Fibre Cement Roof Sheets (Anthracite Grey)
Access Gates to 2x Private Loose Boxes
Remaining Gates serve as external feed and staff access to Animal Barn
EAST FACING ELEVATION
PV Panels
Fibre Cement Roll Top Bargeboard
Yorkshire Boarding
Public Entrance and Exit via Access Ramp
Galvanised Stanchion
45mm round hand rails and posts
Wooden cladding to xxmm
Hand rails at 1000mm on levels
Hand rails at 850mm on slopes
Access Ramp at 1:20 Incline
CROSS SECTION
32384
Brown Area = Finished Ground Level
Green Area = Existing Ground Level
Fence Location for Service Compound
Existing Demonstration Barn
Building:
Proposed Livestock Barn
Title:
Materials and Functions
Drawn by: KL
Checked by: DA
Date: 17.05.16
Scale: 1:200 @A3
File Ref: CFP11
Revision: FINAL
Cotswold Farm Park


32384
12423
PV PANEL: SPECIFICATION
Height: 1000mm
Width: 1650mm
Spacings: 25mm
Cells: 156x156mm
Columns: 30 panels
Rows: 7 panels
TOTAL: 210 panels
Kilowats: 0.25 per panel
KW output: 52.50kw
156
1650
1000
Building:
Proposed Livestock Barn - PV Panels
Title:
Plan View of Roof
Drawn by: KL
Checked by: DA
Date: 22.03.2016
Scale: 1:150 @A3
File Ref: CFP11a
Revision: FINAL
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Cotswold Farm Park, Guiting Power, Cheltenham, Gloucestershire, GL54 5UG
01451 850 307 | www.cotswoldfarmpark.co.uk
Adam Henson's Cotswold Farm Park

The business owners (tenants) are well known to Robert Llewellyn and are supportive of the idea of community-owned assets as part of their business. Since the PV panels are not central to running the Farm Park business, it makes sense for the business to preserve its investment capital for other purposes, and invite an external group to invest in the PV. There is also a potentially strong beneficial story about collaboration between the business and its local community which could become part of the business's marketing communications.

## 5.3 Financial Projections

TGCE has not yet explored sources of funding. The assumption at this stage is that funds will be raised in the form of member investments, and that debt financing will not be sought. No preparation has yet been made for a community share issue, and this will be a priority as soon as the project is confirmed and TGCE is committed to it.

Self-consumption of the bulk of PV generation is essential to the economics of the scheme. A PV consultant has already established that most of the 50kW PV generation will be self-consumed. The Farm Park presently pays a typical tariff, slightly above 10p/kWh, on profile class 3 (non-domestic, unrestricted) electricity supply. It will be necessary for TGCE to agree with the Farm Park that all PV electricity consumed on site (not exported) will be paid at a rate below their current supplier rate (to make it commercially worthwhile for them), but at a rate higher than the default FIT export rate (presently 4.91p/kWh). This suggests a rate of around 7.5p/kWh, which has been used in this financial model.

In order to ensure that close to 100% of PV generation is consumed on-site, it may be economically beneficial for the Farm Park to invest in electric water pre-heating (tanks with immersion heaters plus associated controls), considering that the kitchens are likely to have a fairly high hot water consumption. However for the sake of the financial modeling here, we have not included any cost for on-site load dumping into water heating, and assumed that 80% of PV generation is consumed on-site.

For the sake of this outline feasibility study we have used PV-GIS software to estimate yield. A more accurate yield calculation can be made by the chosen PV installer. The reduced yield from the north facing panels will impact the choice of inverter(s) and possibly on-panel optimisers or micro inverters to ensure that the lower output of the north facing panels does not reduce the potential output of the south-facing panels.

**Simple, high level financial model**

A simple viability check uses a financial projection for Farm Park PV with the following simple assumptions:

- Installed capacity: 50kW (note that the FIT rate falls sharply for schemes larger than 50kW, so the current planned 52kW (as shown on the planning application drawings), would not be economic.
- Fraction of all panels to be south-facing with 15 degree slope: 4/7
- Fraction of all panels to be north-facing with assumed kicked-up to 0 degree slope: 3/7
- Total annual generation using 50:50 mix of PVGIS classic and PVGIS SAF (see http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php#), for the Cotswold Farm Park location, with the panel slopes as indicated: 41,600 kWh
- Fraction of power consumed in the Farm Park: 80% (20% exported)
- Tariff for self-consumption: 7.5p/kWh
- FIT generation tariff, assuming commissioning in July-September 2017, at 4.91p/kWh
- FIT export tariff for power exported from site 4.91p/kWh

- The FIT deployment cap for 10-50kW schemes is not breached before commissioning, so no contingent degression
- Total annual operating costs set at 3% of capex (note that any financial model will be very sensitive to opex, and therefore TGCE must have complete clarity on all such costs from the installer(s) before proceeding)
- Capital costs for the scheme set at £900/kW installed (note that roof installation costs continue to fall, and TGCE will need to test the market thoroughly before finalizing the financial model. The £900/kW figure assumes that panels are installed at the same time as the building is roofed, so there is no additional charge for scaffolding. This will require careful coordination with the Farm Park's building contractors).
- No value has been estimated for legal or other set-up costs.

These assumptions give the following outputs:

- Total capex: £45,000
- Total annual gross revenue: £4,650
- Annual operating costs (excluding financing): £1,350
- Total net revenue (after operating costs, excluding financing): £3,300
- Simple Payback Period: 13.6 years
- Simple rate of return on capex: 7.3%

These high level projections suggest the project is viable for TGCE, but it must be emphasized that with an individual small project such as this, where its over- or under-performance risk cannot be diluted by sharing among other projects, the financial success of the project will hinge on cost of legals and cost of operation and maintenance, and would be vulnerable to unforeseen events (such as grid outages or unusually low solar radiation).

**Cash flow analysis**

A more detailed 25 year cash flow model has been built for the project in order to refine the simple viability check above. The model assumes all operating costs and FIT (generation and export) tariffs rise with RPI over the project life, and that income from local electricity sales to the Farm Park rise at a lower rate of inflation.

This more detailed cashflow model indicates a basic project IRR of 6.2% (ie, the rate of return from all cashflows, taking account of inflation, over the project lifetime), sufficient cash to repay members the principal sum plus interest, and the creation of a £6k community fund.

This suggests that the project is viable on the basis of the assumptions made. However it must be noted that this model presently assumes no benefit to Cotswold Farm Park other than an approximate £1,000 per year saving in electricity cost. No contingency has been allowed for, no replacement of modules or inverters has been modeled, and no impacts of higher or lower solar radiation years has been modelled.

The high level outputs are:

- 6.2% project IRR
- £1k per year benefit to the Farm Park
- Approx 7.5% annual return to members including capital repayment
- £6k community fund built over project lifetime

The inputs, assumptions and outputs of the model are summarised below:

**Temple Guiting Community Energy**

Cotswold Farm Park PV array: 25 year cashflow model

| Inputs | Value | Units | Comments / assumptions |
|---|---|---|---|
| Array size | 50 | kW | Must be 50kW or below to get favourable FIT rate |
| EPC Contract | 45 | £k | Engineering, Procurement and Construction contract to install the PV array, covering panels + connection |
| EPC Contract | 0.9 | £k/kW | EPC contract measured per kW installed |
| Legal fees | 3 | £k | This assumes that the roof lease and other legal documents are straightforward. Some pro-bono support may be needed |
| survey | 0 | £k | No separate survey is required, or else will be subsumed in the EPC contract |
| Stand | 0 | £k | The cost of additional brackets on north side is subsumed in the EPC contract |
| Grid connection | 0 | £k | No separate cost for grid connection; connection is 'behind the meter' at the main grid connection point for the Farm Park |
| Total capital cost | 48.9 | £k | Total capital cost to build the project |
| Tot per kW capital cost | 0.96 | £k/kW | Total capital cost to build the project, expressed per kW of installed capacity |
| Operations | 1 | %/yr | Annual cost of regular operations, expressed as %age of capex |
| Insurance | 0.4 | %/yr | Annual cost of insurance, expressed as %age of capex |
| Degradation | 0.5 | %/yr | Assumed maximum rate of degradation of panel performance (ie, conversion of sunlight to electricity) per year. |
| On site use | 80 | % | Assumed fraction of total PV generation that will be consumed and paid for by the Farm Park |
| Solar FIT | 0.0419 | £/kWh | Assumed FIT generation tariff rate at the time of commissioning (4.19p/kWh) in 2017 |
| Export tariff | 0.0491 | £/kWh | Assumed FIT export tariff rate at the time of commissioning (4.9 |
| On site tariff | 0.075 | £/kWh | Assumed tariff rate (7.5p/kWh) agreed with Cotswold Farm Park for electricity supplied by the PV panels and consumed on-site |
| Solar yield | 832 | kWh/kWp | Assumed annual electricity production per kWp installed - based on established software assuming northern panels are horizontal |
| Elec inflation | 2 | %/yr | Assumed annual rate of inflation of electricity price over the 25 year project life |
| RPI | 1.5 | %/yr | Assumed annual rate of general inflation (RPI) over the 25 year project life |
| O&M | 10 | £/kW | Asumed Operations and Maintenance contract cost, expressed as £ per kWp installed capacity of array |

| Outputs | Value | Units | Comments |
|---|---|---|---|
| Electricity output | 41.6 | MWh | Total annual metered output of the solar array |
| FIT gen' income | 1.74 | £k/yr | Annual income from FIT generation tariff |
| FIT export Income | 0.41 | £k/yr | Annual income from FIT export tariff |
| On site income | 2.496 | £k/yr | Annual income from sale of power to Cotswold Farm Park |
| Project IRR | 6.19 | % | Internal Rate of Return of the project (the discount rate at which Net Present Value = zero) |
| Fund Size | 5.9 | £k | The total value of payments made to the community fund over the 25 year project life (un-discounted) |
| Value to Farm Park | 998.4 | £/yr | The annual cost saving to the Farm Park by buying PV power at a cheaper rate than power from their supply company |
| Member payments | 89.5 | £k | Total value of repayments to TGCE members over the 25 year project life (un-discounted) |
| Member IRR | 5.67673 | %/yr | Internal Rate of Return for members (on project life cashflow including capital outlay and all repayments) |

As a priority, TGCE should now take this model and use it to test the sensitivity of the business case to changes in input variables, to understand in detail the impact of different risks, to build confidence in the business case and as a basis for negotiating with the Farm Park, seeking prices from installers, and preparing a fundraise.

It is likely that TGCE will need to limit the percentage return to investors (members) to a much more modest amount than is typical for larger community renewable energy investments, to reflect the greater risk inherent in a single small project. For example a figure of just 2% above short-medium run RPI could be appropriate.

## 5.4 Planning & Permitting

Planning permission for a 50kW array is already granted (Cotswold District Planning Authority reference 16/02375/FUL). Had TGCE been a partner in the development of the PV proposal from the outset, it might have been possible to submit a planning application for an asymmetric portal frame building, with a much larger southern roof aspect and smaller northern aspect, and to have placed all panels on the southern side. This would have usefully increased solar yield compared to the present proposal. However it is very unlikely that the Farm Park will want to revise any plans and risk increasing cost at this late stage, and therefore the solar yield will have to be calculated on the basis of the presently proposed panel distribution.

Solar yield for the panels on the north facing roof would increase if they were ‘kicked up’ using brackets to stand off the bottom edge and slope the panels to the south. This may not carry a significant cost burden, but would require an amendment (possibly non-material) to the planning application, and so may not be feasible at this stage.

For a sub-50kW installation, the MCS route is followed (rather than ROO-FIT). This means that application is made to Ofgem for FIT accreditation once installation is complete. Nonetheless, pre-registration of the Farm Park scheme with Ofgem is advised. This may provide benefit to TGCE by relaxing the EPC requirement for the Farm Park buildings. TGCE should refer to " Feed-in Tariffs: Guidance for community energy and school installations (Version 3)" (April 2016) available from: https://www.ofgem.gov.uk/system/files/docs/2016/04/fit_community_and_schools_guidance_v3.pdf

Permission from the DNO, WPD, should be formally sought. The technical content of the DNO application needs to be provided by the chosen PV installer, who will have to specify details of panels, inverters, protection equipment etc.

WPD has indicated that, assuming the business goes ahead with a planned (and essential) new grid connection, then there should be no problem connecting the 50kW of PV.

An e-mail reply from WPD relating to the Farm Park is below:

> Cotswold Farm Park – this supply point could only currently accept 3.68kW (16 Amps) under G83/1 guidelines. As per the current offer proposals to upgrade the network & supplies across the Farm presented to Duncan Andrews this supply will be removed & replaced with a new larger overall supply via a new dedicated substation within the site. As a result of the network/cable upgrades that larger supply can accommodate 50kW initially without any further work involvement or added costs from us. (ie no Witness Test required). This has all been referenced in the offer issued to them.
> It should pose no further significant problems, if they decide to then add a further 50kW at a later date. If assuming that is to be added through the same metering point as the initial 50kW, that would trigger a requirement for us to re-attend to carry out a 'Witness Test' – at the same fee of £705 + VAT (please note this price is based on current day rates & may increase in future)

## 5.5 Site

Solar resource is adequate at the site, being around 910kWh/kWp for optimally-sited panels (50:50 split of PVGIS Classic and SAF).

The Farm Park cannot presently install 50kW of PV, because of the very constrained existing grid connection. However, the Farm Park has the intention of upgrading this connection in order to support the business expansion and new buildings on site. WPD has indicated that, once the new strengthened grid connection is in place, there should be no problem connecting 50kW of PV.

We have identified that the northern slope panels should be kicked up so that they are either at least horizontal or better, slightly sloped to south. There would probably be a change to wind loading by using kicked-up panels, and this would need to be accounted for by the contractor erecting the barn, as well as the PV installer, as part of their standard structural loading calculations. It is very unlikely that it would require any strengthening to the barn roof. There would also be some slight reduction in direct sunlight through the rooflights on the northern roof slope, and depending on the final angle of the panels there may be issues with dirt build-up – PV panels can be regarded as effectively self-cleaning when mounted above a certain pitch, but the pitch in this case is shallow and the panels may therefore require more regular manual cleaning.

Approval for the investment and installation will be required from the landowner, as well as the Farm Park (the business is a tenant). The landowner, Dawsonrentals Truck & Trailer Ltd, has indicated that they are unlikely to have any objection in principle, but it will be very important for TGCE to understand all commercial and practical concerns the landowner may have, and have a solution to all of these. The key concerns already discussed with the landowner are potential risks and future costs to the landowner or to Cotswold Farm Park as a result of unforeseen events with either the PV installation or the community energy company itself (such as winding up), and getting clarity on what happens with the panels at the end of the project life. It is likely that all issues can be solved with goodwill and pragmatism on both sides, but there is some risk to the Farm Park PV project of cost overrun in legal fees.

A roof lease, or equivalent licence arrangement, will need to be agreed with the building / site owner in order for the project to proceed. An experienced installer of agricultural roof-mounted PV should have standard lease forms that could be used or adapted.

## 5.6 Operation

TGCE will need to take great care with project operation to ensure the project performs correctly, unforeseen costs are avoided, returns to members are safeguarded and confidence is built among all stakeholders.

The cashflow model assumes an Operation and Maintenance contract is put in place at a cost of £10/kWp/year. This is achievable but there will be upward pressure on this cost because of the relatively isolated location and small size of the installation. In addition the cashflow model assumes around £500/year of direct costs for operation. This would go some way to off-setting costs of any panel or inverter replacement.

Both O&M and direct operations costs can be minimized if TGCE members are prepared to take on some physical duties directly. These could include, eg, panel cleaning, system checks and meter reading. TGCE and the Farm Park will need to take duty of care and health and safety legislation seriously, and this may (but does not need to) preclude any TGCE member from, eg, accessing the roof for panel cleaning and inspection. Any involvement of TGCE members or other non-professionals in system maintenance will need external advice, an operational plan, and inclusion in insurance cover.

System warranties and guarantees will need to be negotiated prior to letting the EPC contract. We recommend that TGCE accesses expert external assistance in evaluating EPC proposals. Tier-1 panels and inverters should be specified, and the coverage, response time and bankability of warranties and guarantees must be carefully assessed.

## 5.7 Funding

Given the small scale of the project and its timing (only the 50kW Farm Park PV is likely to be installed during 2017), it will be very hard, and probably prohibitively expensive, to access debt (the cost of arranging debt would be too high relative to the amount borrowed and the project returns). The only realistic potential for debt funding might be a small direct investment by the Farm Park business or the landlord, providing a stake in the success of the project, individuals in the village proposing a private loan, or specialist organisations with the ability to make small loans.

It may be valuable for TGCE to discuss with Pure Leapfrog (see www.pureleapfrog.org), which may be able to offer small scale finance and has template contracts that might make contracting for the Farm Park PV quicker and cheaper than it might otherwise be.

To make the project work it is likely that all capital will need to be raised as equity, from TGCE members through a community share issue. The appetite in the village for raising finance through membership has not been tested at this point, but given the enthusiasm already shown, the relatively modest capital requirement (of the order of £50k for the Farm Park PV), and the relative affluence of the village, it seems likely that equity would be forthcoming. 25 investors at £2k each would appear viable.

## 5.8 Scheduling

Cotswold Farm Park has the intention of completing the new builds during 2017. This means that TGCE should commence detailed negotiations with the Farm Park and landlord forthwith, in order to coordinate fundraising and letting contracts with the time window for installation.

It is essential in keeping installation costs down that the PV installer can be on site to coordinate with the contractor erecting the barn. This ensures that an unnecessary separate cost for scaffolding is avoided. However, this requires good communication and coordination through the main project manager for the Farm's development project.

The following simple check list and timeline is suggested as a starting point for TGCE:

| Timing | Action |
|---|---|
| Now | Build project team and create first-cut project plan. Write short project summary and proposal to help all stakeholders understand the vision and how they can take part. |
| Now | Register TGCE as a Community Benefit Society, and submit pre-registration and community energy verification to Ofgem. |
| Now | Commence negotiation with Farm Park on a) Farm Park participation in fund raise, b) modeling likely consumption of PV generation in Farm Park operations, c) price for roof lease and / or reduced cost electricity supplied to the Farm Park, d) understand scheduling for the barn build, e) investigate whether non-domestic EPCs exist for the buildings being supplied with PV power. |
| Now | Commence negotiation with landlord starting by submitting a written proposal on TGCE's investment into the PV scheme, and the benefits that will accrue to the Farm Park, village and the landlord. |
| Early November | Village meeting to launch the community energy company in principle, present the Farm Park investment project in detail, and establish appetite for investment |
| By mid November | Select provisional EPC providers, through online reviews and recommendations from external experts / other community energy companies. |
| By mid November | Clarify the EPC requirement for Farm Park buildings in relation to community-owned FIT application |
| By end November | Complete detailed cashflow model to test risks and underlying assumptions |
| By end November | Register TGCE as a Community Benefit Society and produce outline draft of the fundraise document. Set date for first formal meeting of the Society to elect or confirm Chair and other officers. |
| By mid December | Finalise negotiations with landlord and Farm Park and capture in an MoU / LoI. Establish list of preferred EPC suppliers and establish evaluation criteria for technical bids. Write draft fundraise document. |
| Mid-end January 17 | Invite bids for the EPC contract; discuss with bidders; incorporate bid values into the cashflow model. Select preferred bidder. Finalise fundraise document. |
| By end January | Launch fundraise. |
| By end Februrary | Close fundraise, confirm EPC contract |
| March onwards | Ready to build |

# 6 Wind turbine on Pinnock Hill

## 6.1 Summary

Whilst the project looks as though it could be just feasible from an economic perspective, the group will face a significant task in achieving the project. The key issue is planning risk considering the AONB context, and the group would need to demonstrate active support for the project by the large majority of people living close by. On the basis of wind applications in the AONB in recent years this will be difficult. There are also significant risks in statutory objections from CAA / RAF, and these would need to be addressed at the outset. Overall, the likelihood of success of this project is small.

TGCE recognizes that wind turbine technology is problematic in a protected landscape setting. Very few wind turbines exist within the Cotswolds AONB, and those that do are small, and/or the developers had to go to appeal (and bear additional costs) to get permission.

The reasons for not dismissing the wind project out of hand are:

- The existence of an 11kV circuit, conveniently close, which would have sufficient capacity to take the output of a 50kW turbine
- Indication that wind resource may be sufficient to generate an acceptable return on investment
- The site owners (local farmers) are strong supporters, in fact originators, of the proposal
- TGCE might be in a position to marshal strong local support for a planning application

Set against these positives are:

- On current projections the project seems to have marginal economic viability
- The viability is very sensitive to O&M contract cost and windspeed. It will take considerable time and cost to achieve a high degree of confidence in site windspeed.

It is clear that applying for planning permission for wind in the Cotswolds AONB has a high chance of failure. From comments at local meetings it is clear that (as should be expected) that support for a local wind turbine will not be 100%. For this reason, TGCE should proceed with caution, and only commit effort and resources to such an application if they have done extensive ground work to mitigate all risks. Given the limited resources TGCE has, they should focus on the first instance on the PV project on Cotswold Farm Park, and make pursuit of the wind project a second order priority only.

## 6.2 Technology

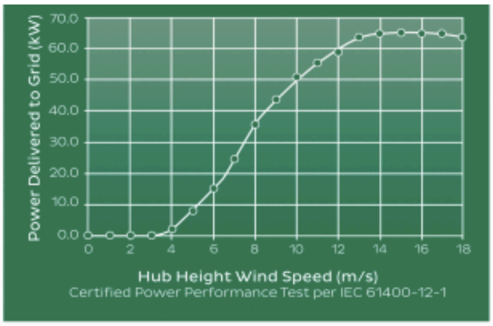
Choice of turbine size is crucial. We have not undertaken any analysis of how rates of return vary between turbine sizes at the site in question. This is partly due to the fact that the installed cost of a turbine can only be known once quotations have been received, linked to the specific site. Site conditions (access, ground condition etc) can strongly influence the installed cost.

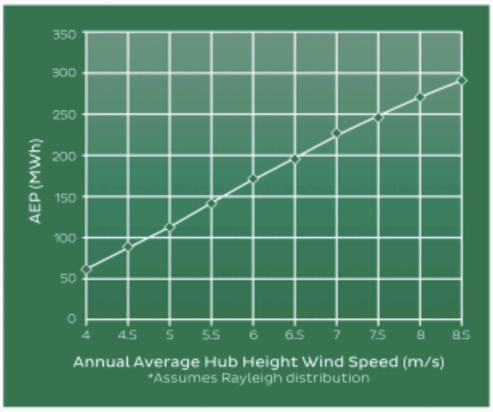
A key characteristic of the site is the absence of an electrical load. Had the site been in proximity to a factory, hotel or other site with a significant electricity demand, it could have been connected ‘behind the meter’ and power consumed on site would have a higher economic value, significantly improving the overall project economic case. In the absence of such a load the turbine will need to connect directly to the grid and be ‘export only’. Therefore the suggestion for a 50kW turbine is a judgement of the best compromise that balances cost of connection, return on investment, visual impact (and therefore planning risk), grid capacity and site suitability.

Wind turbines can be more or less visually appealing.  An example of a well established, visually clean, 50kW turbine with a good track record in the UK is the Endurance E-3120, and the performance data for this turbine has been used in the simple financial estimates here.  We must emphasise that this report is not an endorsement or promotion of this specific turbine or manufacturer.  The turbine is illustrated below:

The key technical characteristics are as follows:

| E Series Specs | E3120-4 50kW |
|---|---|
| **Turbine** | |
| Configuration | Three blade, horizontal axis, downwind |
| Rated Power (kW) | 50kW at 10 m/s |
| Application | Direct Grid Tie |
| Rotor Speed (RPM) | 43 |
| IEC 61400-1 Turbine Class | IIIA except annual average wind speed can be up to 8.5 m/s |
| Maximum Average Wind Speed (m/s) | 8.5 |
| Survival Wind Speed (m/s / mph) | 52 / 116 |
| Cutout Wind Speed (m/s) | 25 |
| Overall Weight (kg / lbs) | 3990 / 8800 |
| **Rotor** | |
| Rotor Diameter (m) | 19.2 |
| Swept Area ($m^2$) | 290 |
| Blade Length (m) | 9 |
| Blade Material | Fiberglass Composite |
| Power Regulation | Stall control |
| **Generator** | |
| Generator Type | Asynchronous, Induction |
| Configuration | 3-phase, 400 VAC, 50 Hz |
| **Brake & Safety Systems** | |
| Main Brake System | Rapid Fail-Safe dual mechanical brakes |
| Secondary System | Spring-loaded pitch mechanism for over-speed regulation |
| Automatic Shutdown triggered by | High wind speed, grid failure, over-speed, all other fault conditions |
| **Controls** | |
| Control System User Interface | Programmable Logic Controller (PLC) |
| | ERIC™ Endurance Remote Interface Centre |
| **Towers** | |
| Available Hub Heights (m) | 24.6 and 36.4 |
| Tower Type | Free Standing Monopole, Safe climbing system |
| **Warranty** | |
| | Standard – 5 year parts and labour |
| CE Compliant | Yes |




| Annual Average Hub Height Wind Speed (m/s) | Annual Energy Production (kWh) |
|---|---|
| 4.0 | 61 600 |
| 4.5 | 87 800 |
| 5.0 | 113 900 |
| 5.5 | 141 700 |
| 6.0 | 169 400 |
| 6.5 | 195 900 |
| 7.0 | 222 400 |
| 7.5 | 246 100 |
| 8.0 | 269 900 |
| 8.5 | 290 100 |

## 6.3 Financial projections

The projections here are necessarily crude, given the number of unknowns at this early stage. It will be essential for TGCE to review the estimates here using real costs from turbine suppliers before concluding the financial viability of the site. The very simple model shows simple payback periods (years) for different assumptions, as a first-pass indicator of possible viability. As a simple yardstick if the project does not pay back in less than about 12 years it is unlikely to be viable.

The following input assumptions are made:

- Installation assumed 1st quarter, 2018
- FIT generation rate in force is 7.99p/kWh, and the <50kW wind deployment cap has not been breached
- FIT export rate in force is 4.91p/kWh
- Lower estimate of capital cost, installed is £215k (upper and lower estimates of E-3120 installation cost from www.switchedonenergy.com)
- Upper estimate of capital cost, installed is £265k
- Installation costs are inclusive of grid connection

- O&M contract cost is set at 3% of the average of upper and lower capex – note that O&M could be up to 5% or more, given the isolated nature and small scale of the turbine (indicative values from the 2009 EWEA report The Economics of Wind Energy)

The simple model does not include, ia:

- Insurances
- Impact of grid outages
- Contingency

The simple financial model projections are given below, demonstrating the high sensitivity of all wind projects to mean annual average wind speed:

| wind speed, m/s | yield, kWh | FIT | | PPA | | total | | O&M / year | | SPP, years low capex | SPP, years high capex |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 113,900 | £ | 9,101 | £ | 5,592 | £ | 14,693 | £ | 7,200 | 29 | 35 |
| 5.5 | 141,700 | £ | 11,322 | £ | 6,957 | £ | 18,279 | £ | 7,200 | 19 | 24 |
| 6 | 169,400 | £ | 13,535 | £ | 8,318 | £ | 21,853 | £ | 7,200 | 15 | 18 |
| 6.5 | 195,900 | £ | 15,652 | £ | 9,619 | £ | 25,271 | £ | 7,200 | 12 | 15 |
| 7 | 222,400 | £ | 17,770 | £ | 10,920 | £ | 28,690 | £ | 7,200 | 10 | 12 |

For the project to be viable TGCE would need to:

- Get assurance that mean annual average wind speed is around 6.5m/s or better, and that estimates are reliable (starting by requesting data from the limited number of turbine owners in the same broad area of the Cotswolds), and may require anemometer readings taken over several months
- Negotiate a highly competitive O&M contract, probably at 3% of capex or better
- Undertake as much of the O&M activity as possible using TGCE members, to push down O&M annual charges
- Negotiate a highly competitive EPC contract
- Consider investing in a second hand turbine, which has the ability to dramatically improve the return on capital at the expense of some additional risk. Choosing a second hand turbine will require expert assistance, and may cause difficulties with planning since the type, height and appearance of the turbine are material, and second hand turbines have less availability

## 6.4 Planning and permitting

The single greatest risk to the project is obtaining planning permission. The site is within the Cotswolds Area of Outstanding Natural Beauty, and the small number of previous planning applications for single wind turbines elsewhere in the AONB have typically either been refused, or upheld on appeal, with unacceptable visual impact in the AONB being the key objection.

Other single wind turbines granted permission within the AONB have tended to be smaller than the 50kW turbine proposed here. Nonetheless 50kW would appear to be the smallest viable size for this location in order to offset the necessary grid connection cost.

Discussion has been held with a Cotswold District Council planning officer, who advises that he would generally 'steer applicants away' from wind proposals because of the dominance of the AONB in determining outcomes.

Cotswold District Council is preparing a comprehensive Local Plan for 2011 to 2031, and should submit a single comprehensive Local Plan for examination in 2016, although it will be a further year before this is adopted. Whilst a draft of the new Local Plan covers renewable energy issues, for now the existing Cotswold District Local Plan 2001-2011, adopted in 2006, remains in force.

The 2001-11 Local Plan contains the following relevant sections and policies:

> **2.2.10** In the Cotswolds, although a variety of renewable energy projects may be proposed, the most likely installations will relate to solar or wind power, through the provision of solar panels or erection of wind turbines. If insensitively located, solar panels can cause visual harm, particularly to listed buildings and within conservation areas. Wind turbines can fulfil an important role in the creation of energy, but they can also have a visual impact over a wide area that can be unacceptably damaging. The noise of blade movement and interference with radio transmissions can also cause problems. When turbines are grouped in numbers to create 'wind farms' their impact on the landscape is likely to be particularly great. The Cotswold landscape, especially the open, unspoilt vistas over the high wolds and the dramatic skyline of the escarpment edge, is likely to be particularly vulnerable in this respect, such that acceptable sites may well be difficult to find.

POLICY 2: RENEWABLE ENERGY

Proposals for renewable energy installations will be permitted provided that the proposed development:

(a) would not result in any significant loss of amenity due to noise or interference with telecommunication reception;

(b) would not result in an unacceptable risk to public health or safety, including harmful environmental effects from any associated transmission;

(c) does not, by its visual impact, significantly harm the character or appearance of the Cotswolds AONB, Special Landscape Areas, historic landscapes, archaeological sites, or the character or setting of Conservation Areas or listed buildings;

(d) does not significantly harm the ecology of habitats, other biodiversity interests or sites of archaeological importance; and

(e) is justified, where necessary, in terms of national energy policies of local and regional requirements.

It is instructive to review the documents associated with a live planning application for two small wind turbines (smaller than the 50kW turbine proposed here) close to the village of Withington, south-east of Cheltenham, and within the AONB (reference 16/01657). The Cotswold District Council landscape officer proposes refusal on the grounds that the two turbines would constitute unacceptable urbanization, despite their close proximity to existing National Grid pylons of much larger size and visual impact. It is important also to note the strength of local objection to the scheme evidenced through the large number of individual letters of objection, almost all on the grounds of visual impact and protection of the landscape views within the AONB.

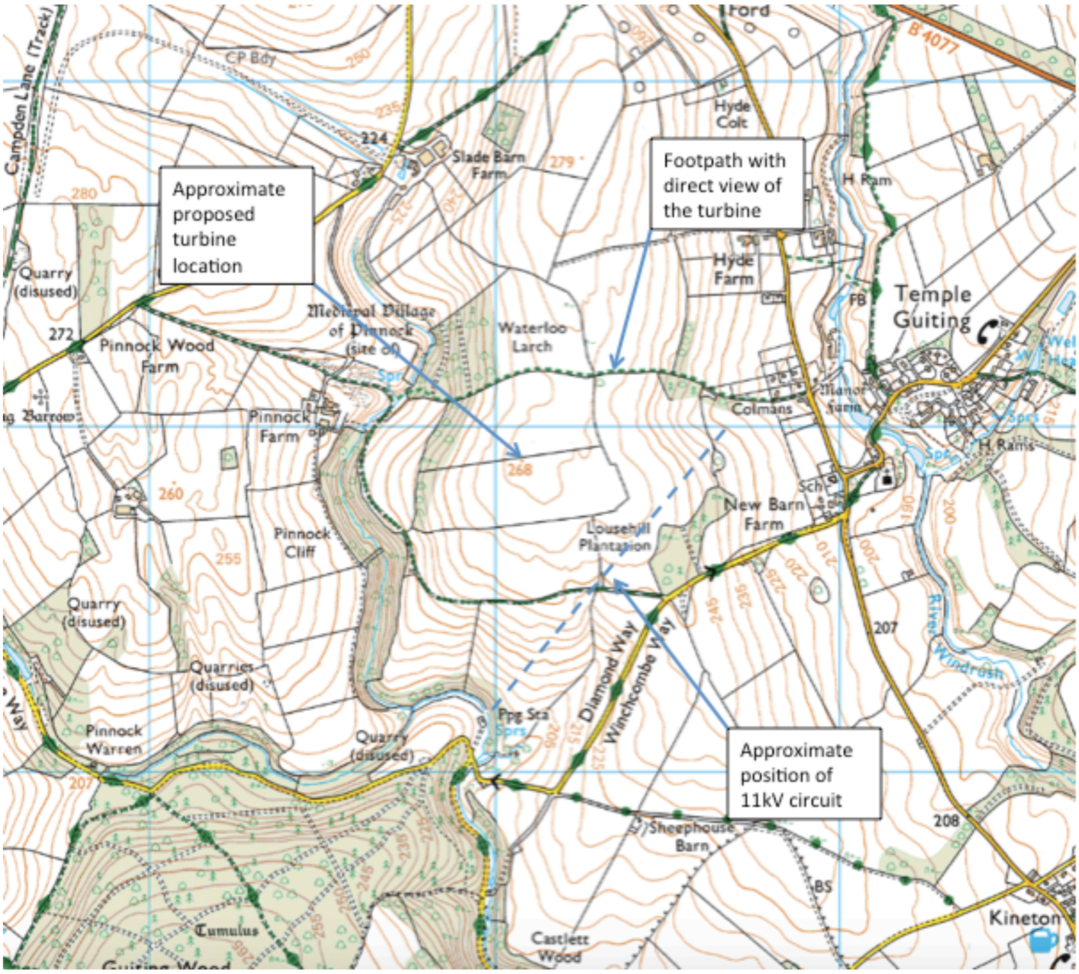
Two planning applications for wind turbines within the AONB made in 2011 (see references 11/04407 and 11/03756) are instructive also. An application for a very small turbine (10kW rating on a 25m tower), close to existing National Grid power lines, was approved on appeal following initial rejection on visual impact grounds. The second, similar of similar size, was rejected.

In the application reference 11/04407, proximity of the proposed turbine to a footpath, and the effect on the views from that footpath, was significant. The Pinnock Hill location will be close to the footpath (marked) between Pinnock Wood Farm and Temple Guiting. It is likely that the turbine will directly affect any views to the south from that footpath, and this may be a key consideration in the application process.

In 2015, in parallel with substantial reductions to the Feed-In tariff support for onshore wind, the Secretary of State for DCLG sought to give greater power to local people have the final say on wind farm applications, requiring that permission can only be granted if "it can be demonstrated that the planning impacts identified by affected local communities have been fully addressed and therefore the proposal has their backing." Whilst no specific guidance is available to define what constitutes the ‘backing’ of the local community, it is clear that TGCE would need to carry out an extensive and transparent consultation process and be able to document the support of the majority of people living in the area.

## 6.5 Site

The site proposed is the summit, or near summit, of Pinnock Hill, above Pinnock Farm (the landowner and enthusiastic supporter), and shown on the map below.

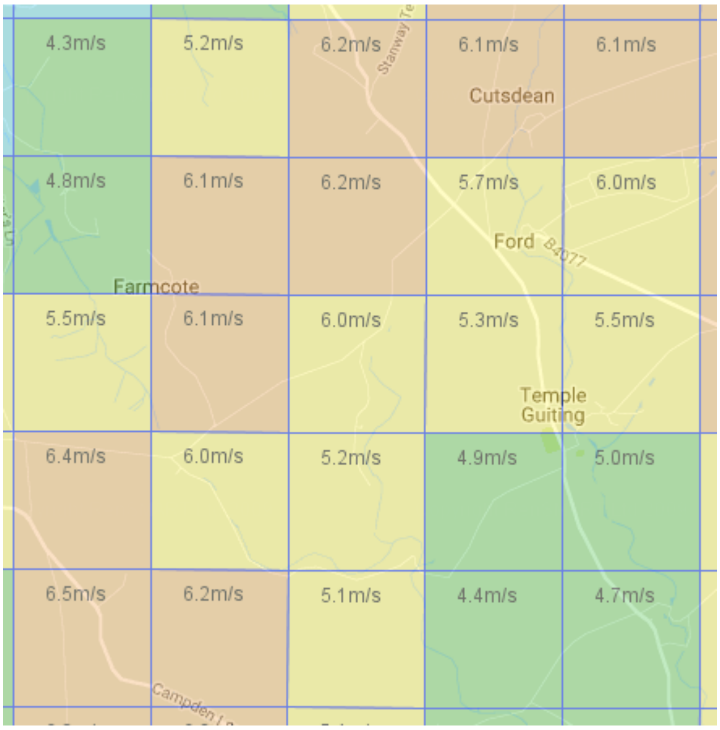



### Leasing

Leasing land for the turbine and necessary access is likely to be straightforward given the enthusiasm of the landowner.

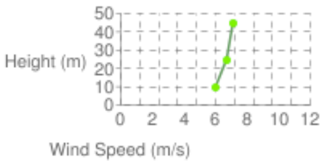
### Wind resource

The wind resource at the site has been assessed using the publicly available NOABL wind speed estimation tool, accessed through www.rensmart.com, with the results below, suggesting that windspeed at 25m hub height may be as high as 6.7m/s.:




Latitude: 51.952380626464056
Longitude: -1.8899917602539062

| Height Above Ground | Wind Speed |
|---|---|
| At 10 meters | 6 m/s 13.4 mph |
| At 25 meters | 6.7 m/s 15 mph |
| At 45 meters | 7.1 m/s 15.9 mph |




The NOABL database provides a rough approximation only, built from fairly crude airflow model with geographic input data such as altitude and assumed surface roughness. We note that the actual windspeed on the crest of Pinnock Hill will be strongly influenced by local topology that does not feature in NOABL, given the resolution of the NOABL model is one kilometer. Specifically, there is an un-interrupted wind run in the prevailing wind direction (ie, no trees or bushes or buildings), and it is likely that there will be some wind concentration effect at the crest of the hill that will tend to push up annual wind speed value. The NOABL database suggests wind speeds are stronger to the north and west of the turbine location, in keeping with the higher elevation. However, it is likely that Pinnock Hill would share these higher windspeed values.

**Grid connection**
Extensive discussions have been held with WPD about the grid constraints and connection opportunities at all project sites. Whilst it is not possible for WPD to provide an accurate estimate of grid connection cost at this point, they have confirmed:

- The circuit running north-south through the valley and to the west of Temple Guiting could (at present) accommodate up to 250kW of renewable generation
- The 11kV circuit running closest to the turbine location would have sufficient capacity to take 50kW generation, but the best connection point would need to be determined – either

at the pumping station at the bottom of the hill to the south west of the turbine, or else a new transformer closer to the top of the hill, with a T-in to the circuit.

**Access**

There are no tarmac roads accessing the site. Access for construction is therefore likely to be via farm tracks and through field gates. Only off-road vehicles would be able to access the site, and this could have a significant cost impact which would need to be assessed early in the detailed site evaluation. The time of year when construction happens is likely to have a significant effect on construction costs.

**Other site constraints**

No assessment has been made of possible interference with radio, microwave, radar or other communication, nor any clash with civil or military flight paths or clearance zones. No assessment has been made of likely sensitivity of the site to bird life. The landowner reports that nearby wind turbine proposals have failed in the past due to objections from either the Civil Aviation Authority or RAF. These factors would therefore need to be assessed as a priority early in the development process.

# 7 Ground mounted PV at Huntsmans Quarry

## 7.1 Summary

The quarry management has expressed willingness in principle to consider a new community-owned ground-mounted PV generator at the site. Extensive modeling (seasonal and half hourly) of new PV generation compared to (current) electricity consumption at the quarry, taking account of the existing 250kW PV array, indicates that most of the PV generation (around 80%) could be used on site (on working days) making the scheme, in principle, viable. However the network operator WPD has indicated that no new PV could be installed at the site without expensive upgrade works to the network in the local area and to the switchgear on site. These costs render the PV scheme uneconomic in the short term.

The quarry may in time choose to invest in an upgraded grid connection, as part of the future development of quarry operations. This may then make a new PV array feasible, but the considerable uncertainty over the future tariff support for PV means that the opportunity will have to be kept under review and re-evaluated if and when the quarry invests in new electrical infrastructure. We recommend that TGCE maintains contact with the quarry to understand whether any changes take place in the quarry's grid connection that might make TGCE-owned PV viable.

## 7.2 Technology

The technology proposed for Huntsmans Quarry is 250kW ground-mounted PV, on an area of the quarry site that is now unused but was once quarried and has since been remediated. An existing 250kW PV array installed some years ago feeds power 'behind the meter' at the quarry and contributes usefully to the quarry's power consumption and reduces its power costs.

The technology is very well established and does not need to be reviewed extensively here. The solar resource at the site (the expected yield of electricity) is estimated to be around 910kWh/kWp/year (50:50 blend of PVGIS Classic and SAF, optimal panel orientation and slope).

**Capacity for new PV generation**

The key question for the site is the extent of new PV generation that can be accommodated. There is an existing 250kW ground-mounted PV array, installed and owned by a commercial company, that supplies power to the site behind the meter. This provides a good return to the array owner and saves the quarry some money.

In order to assess whether new PV generation could be accommodated and would be commercially viable, a complex model was created as follows:

1) The quarry provided half hourly (HH) meter reading for the main electricity incomer (MPAN) meter between July 2014 and April 2016 (some 32,000 data points), and monthly generation data for the existing PV array.
2) Take 2.5 years of HH data and group in 3 categories: weekday, Saturday and Sunday / Bank Holiday, on a per-month basis. Average this consumption over the 2.5 years to give a typical value per HH period for each month of the year.
3) Not having any half hourly data from the existing PV scheme we generated proxy HH generation data for the existing PV array, by using projected output on an hourly basis (from the EU's Photovoltaic Geographic Information Scheme, PVGIS, at: http://re.jrc.ec.europa.eu/pvgis), modified it to present in half hour data points, scaled to the monthly generation data. This gives a 24-hour HH model broken down by month.
4) To determine the approximate net site consumption we added the modelled PV generation and the MPAN import data (since the existing PV generation is connected behind the meter). We estimate an approximate 620,000kWh per annum of actual net site consumption (i.e., removing the existing PV array).
5) This gives the amount of PV generation spilled to the grid, and the amount consumed on-site. We estimate that about 7% of total (current) PV generation is spilled (in line with what would be expected given the size of generation compared to site consumption), and about 40% of the quarry's present total on-site consumption is provided by the existing PV array.
6) The model then assigns priority to the existing PV generation - meaning that its output is preferentially consumed on-site before any additional PV array output. This is to protect the commercial interest of the existing investor
7) We then model different scales of additional PV capacity, in 25kW steps, to see whether the increasing proportion of spill damages the economics. It does, but it's not a strong effect, and will probably be overcome by the better economics of a larger array.

In summary the model results show:

- New PV array size: 250kW
- Total annual generation: 252,000 kWh/yr
- Annual 'spill' (export to grid): 65,000 kWh/yr
- Spill as a %age of generation: 26%
- On-site consumption as a %age of generation: 74%
- Volume sold to quarry: 187,000kWh/yr
- Proportion of quarry on-site electricity consumption met by PV generation rises from (present) about 38% to (with a new TGCE-owned 250kW PV array) about 68%.

These values feed through to the cashflow modeling reported below.

**Grid connection**

WPD has looked in detail at the quarry site, to estimate the necessary cost of upgrade to the existing circuits that supply the site, in the event that the quarry wishes to increase the power it consumes in the future. WPD has also taken into account the potential for an additional 250kW PV array and reports significant challenges and costs. In brief:

- Whilst 250kW of PV is in principle can be accommodated on the network, there are voltage issues meaning WPD would have to replace the existing HV switchgear for a new type of gear with a connected voltage constraint panel.
- The new switchgear and voltage constraint cannot be retrofitted to the existing set up on site.
- The cost of new switchgear is likely to be of the order of £50,000.
- A smaller PV installation would still require the same switchgear upgrade.
- WPD would be required to notify National Grid to obtain a statement of works, which carries a risk that NG may determine potential issues on the transmission network and would then apply their own charges for in depth studies to mitigate risks. It is not possible for WPD to say what these costs may be.
- In addition there is a potential issue with 'reverse power flow' on WPD's 11kV network onto the 66kV network at the Primary station, which could potentially trigger a Transformer change at the Primary with AVC relay changes. This would carry additional costs.
- The fact that the quarry is presently operating close to the limit of its import capacity presents operational and commercial risks to a new PV installation. The existing voltage rise across the network (from the existing PV array) risks pushing the network out of statutory limits, which in turn means that an additional PV array carries the risk of the customer-side protection (G59 relay and inverters) tripping, preventing all generation until the trip can be re-set, leading to additional operational cost and lost generation revenue.

In conclusion, the grid connection for new PV at the quarry is expensive to implement, and carries significant risks of additional unknown costs once a full network study is carried out.

## 7.3 Financial Projections

In order to understand the impact of the estimated £50k additional connection cost, two detailed 25 year cashflows have been modeled, for a 50kW and 250kW installation.

The impact of the £50k connection cost is clearly larger on the 50kW scheme, but this impact is partly offset by the higher Feed-in Tariff that can be claimed for the smaller installation. The smaller scheme suffers from a relatively higher assumed legal fee (the same as the 250kW installation), and the O&M cost has been slightly elevated (expressed in £/kWp installed) to reflect the smaller scheme size.

The input assumptions and results of each cashflow model are given below. On the basis of the numbers assumed here, neither project is viable, and neither generates any community fund value. The smaller 50kW scheme is the least viable of the two.

**50kW scheme**

Input assumptions and results are given in the table below:

Huntsmans quarry 50kW PV array: 25 year cashflow model

| Inputs | Value | Units | Comments / assumptions |
|---|---|---|---|
| Array size | 50 | kW | Must be 50kW or below to get favourable FIT rate |
| EPC Contract | 48 | £k | Engineering, Procurement and Construction contract to install the PV array, covering panels + connection |
| EPC Contract | 0.96 | £k/kW | EPC contract measured per kW installed |
| Legal fees | 3 | £k | This assumes that the lease and other legal documents are straightforward |
| survey | 0 | £k | No separate survey is required, or else will be subsumed in the EPC contract |
| Grid connection | 50 | £k | Approximate cost advised by WPD for export limitation switchgear upgrade |
| Total capital cost | 102 | £k | Total capital cost to build the project |
| Tot per kW capital cost | 2.02 | £k/kW | Total capital cost to build the project, expressed per kW of installed capacity |
| Operations | 1 | %/yr | Annual cost of regular operations, expressed as %age of capex |
| Insurance | 0.4 | %/yr | Annual cost of insurance, expressed as %age of capex |
| Degradation | 0.5 | %/yr | Assumed maximum rate of degradation of panel performance (ie, conversion of sunlight to electricity) per year. |
| On site use | 75 | % | Assumed fraction of total PV generation that will be consumed and paid for by the quarry |
| Solar FIT | 0.0419 | £/kWh | Assumed FIT generation tariff rate at the time of commissioning (4.19p/kWh) in 2017 (<50kW rate) |
| Export tariff | 0.0491 | £/kWh | Assumed FIT export tariff rate at the time of commissioning (4.91p/kWh) |
| On site tariff | 0.075 | £/kWh | Assumed tariff rate (7.5p/kWh) agreed with Huntsmans Quarry for electricity supplied by the PV panels and consumed on-site |
| Solar yield | 910 | kWh/kWp | Assumed annual electricity production per kWp installed - based on 50:50 PVGIS Classic/SAF, optimal orientation |
| Elec inflation | 2 | %/yr | Assumed annual rate of inflation of electricity price over the 25 year project life |
| RPI | 1.5 | %/yr | Assumed annual rate of general inflation (RPI) over the 25 year project life |
| O&M | 13 | £/kW | Asumed Operations and Maintenance contract cost, expressed as £ per kWp installed capacity of array |

| Outputs | Value | Units | Comments |
|---|---|---|---|
| Electricity output | 45.5 | MWh | Total annual metered output of the solar array |
| FIT gen' income | 1.91 | £k/yr | Annual income from FIT generation tariff |
| FIT export Income | 0.56 | £k/yr | Annual income from FIT export tariff |
| On site income | 2.55938 | £k/yr | Annual income from sale of power to Huntsmans Quarry |
| Project IRR | -1.9 | % | Internal Rate of Return of the project (the discount rate at which Net Present Value = zero) |
| Fund Size | 0 | £k | The total value of payments made to the community fund over the 25 year project life (un-discounted) |
| Value to quarry | 853.125 | £/yr | The annual cost saving to the quarry by buying PV power at a cheaper rate than power from their supply company |
| Member payments | -100 | £k | Total value of repayments to TGCE members over the 25 year project life (un-discounted) |
| Member rate of return | -1.9213 | %/yr | Internal Rate of Return of net member payments (initial capital outlay plus all annual repayments) |

Note that TGCE members / investors do not receive their investment back over the 25 year life (there is a net cash outflow of £100k). The project IRR is -1.9%. No community fund is generated. The commercial value to the quarry is estimated at around only £850/year, which would make it difficult for the quarry to prioritise support for a venture of this scale, even if it were to become economic.

### 250kW scheme

Input assumptions and results are given in the table below:

Huntsmans quarry 250kW PV array: 25 year cashflow model

| Inputs | Value | Units | Comments / assumptions |
|---|---|---|---|
| Array size | 250 | kW | Must be 50kW or below to get favourable FIT rate |
| EPC Contract | 230 | £k | Engineering, Procurement and Construction contract to install the PV array, covering panels + connection |
| EPC Contract | 0.92 | £k/kW | EPC contract measured per kW installed |
| Legal fees | 3 | £k | This assumes that the lease and other legal documents are straightforward |
| survey | 0 | £k | No separate survey is required, or else will be subsumed in the EPC contract |
| Grid connection | 50 | £k | Approximate cost advised by WPD for export limitation switchgear upgrade |
| Total capital cost | 284 | £k | Total capital cost to build the project |
| Tot per kW capital cost | 1.132 | £k/kW | Total capital cost to build the project, expressed per kW of installed capacity |
| Operations | 1 | %/yr | Annual cost of regular operations, expressed as %age of capex |
| Insurance | 0.4 | %/yr | Annual cost of insurance, expressed as %age of capex |
| Degradation | 0.5 | %/yr | Assumed maximum rate of degradation of panel performance (ie, conversion of sunlight to electricity) per year. |
| On site use | 75 | % | Assumed fraction of total PV generation that will be consumed and paid for by the quarry |
| Solar FIT | 0.0166 | £/kWh | Assumed FIT generation tariff rate at the time of commissioning (4.19p/kWh) in 2017 (<50kW rate) |
| Export tariff | 0.0491 | £/kWh | Assumed FIT export tariff rate at the time of commissioning (4.91p/kWh) |
| On site tariff | 0.075 | £/kWh | Assumed tariff rate (7.5p/kWh) for electricity supplied by the PV panels and consumed on-site |
| Solar yield | 910 | kWh/kWp | Assumed annual electricity production per kWp installed - based on 50:50 PVGIS Classic/SAF, optimal orientation |
| Elec inflation | 2 | %/yr | Assumed annual rate of inflation of electricity price over the 25 year project life |
| RPI | 1.5 | %/yr | Assumed annual rate of general inflation (RPI) over the 25 year project life |
| O&M | 10 | £/kW | Asumed Operations and Maintenance contract cost, expressed as £ per kWp installed capacity of array |

| Outputs | Value | Units | Comments |
|---|---|---|---|
| Electricity output | 227.5 | MWh | Total annual metered output of the solar array |
| FIT gen' income | 1.74 | £k/yr | Annual income from FIT generation tariff |
| FIT export Income | 0.41 | £k/yr | Annual income from FIT export tariff |
| On site income | 12.8 | £k/yr | Annual income from sale of power to Huntsmans Quarry |
| Project IRR | 2.4 | % | Internal Rate of Return of the project (the discount rate at which Net Present Value = zero) |
| Community fund | 0 | £k | The total value of payments made to the community fund over the 25 year project life (un-discounted) |
| Value to quarry | 4.2 | £k/yr | The annual cost saving to the quarry by buying PV power at a cheaper rate than power from their supply company |
| Member payments | 100 | £k | Total value of net payments to TGCE members over the 25 year project life (sum of annual payments less capex) (un-discounted) |
| Member rate of return | 2.38 | %/yr | Internal Rate of Return of members' cash flows over project life (capex and annual repayments) |
| Cashflow NPV | 32 | £k | NPV of net cashflow over 25 year project life, with discount rate = RPI |

Note that the NPV of cashflows is only £32k over the project life, using a discount rate of (assumed) RPI. Comparing NPV to the total capital cost of the project (around £280k) indicates immediately that the project is extremely marginal.

Project Internal Rate of Return (the interest rate at which NPV falls to zero) is around +2.6%, indicating that the project is barely economic, very vulnerable to any increase in cost, and would require investors to accept a near-zero rate of return. No community fund is created in this model. The commercial value to the quarry is estimated at around £4,200 per year in cheaper electricity supplied by the PV panels.

Total net member payments over the project life (that is, the value of all cash payments from the scheme less the capital cost) is around £100k (un-discounted). This figure could be looked on as a basic arithmetic health check on the project as a whole, but is not as insightful as the NPV figure.

## 7.4 Planning & Permitting

The same basic background to planning applications for renewable energy generation applies, and is described in section 7.

Whilst the quarry is within the Cotswolds AONB, there are strong reasons to suppose that planning permission for a 250kW ground-mounted array is likely to be granted:

- The existing 250kW array had permission granted
- We have not been informed of any local objections to the array that could carry over into a planning application
- The existing array and a new array are hidden from all points of view (highway and footpaths) behind existing hedges and landforms

- Other than traffic during construction, PV arrays are close to silent and entirely non-polluting.
- The land area required for the PV is remediated quarry spoil, and may therefore count as 'brown field'. Whatever its land designation, the proximity of the PV array site to an operating quarry means that danger to protected species or other local environmental impacts that can adversely affect PV schemes are unlikely
- Construction activity for the PV array could be carried out within the quarry's existing limited operating hours (limited by the existing planning permission for quarrying activity)

Correspondence with Cotswold District Council planning department is included in Annex.

## 7.5 Site

Since the quarry has been supportive of the principle of community-owned PV on site, we assume that a lease could be negotiated for use of and access to land by TGCE.

All obvious site conditions are favourable – solar resource, site access.

However we note that, depending on assumptions made, the commercial value of a TGCE PV array to the quarry may be limited and therefore the quarry may not be able to commit significant management time to negotiation of the lease or otherwise strongly facilitate TGCE's project.

# 8 Individual household PV within the village

## 8.1 Summary

Individual households, other than those restricted by listed building status, can install PV systems up to a maximum size of 3.68kW (in practice, 4kW), without restriction, and receive the present level of Feed-in Tariff support. Such individual investments could give a simple payback period of around 12 years for an optimal location.

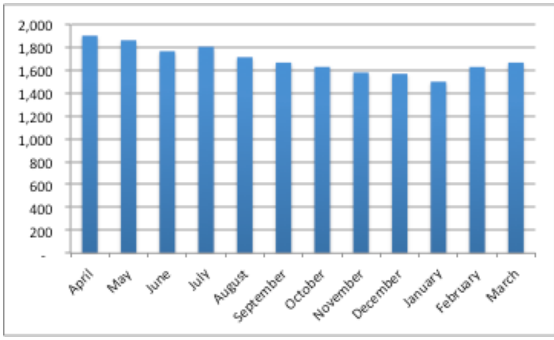
However due to a combination of the FIT rules and electricity grid constraints in the village, TGCE could not act on behalf of multiple households to arrange a ‘collective buying’ deal, or create community ownership of panels leased back to individual households.

Therefore there is extremely limited opportunity for TGCE to play an active role in supporting individual householders installing PV.

## 8.2 Technology

Domestic scale PV technology is well established and does not need to be described here. Prices have been falling and broadly continue to fall, but the rate of installation has dropped following a severe reduction in the Feed-in Tariff, and this will tend to slow the rate of price reduction. Over the medium term, prices of panels and inverters are expected to fall further but certain aspects of the whole installation price (eg the cost of a team of installers, transport, scaffolding, electrician) will not fall at the same rate, if at all.

The fall in cost per kW installed (systems <4kW) from April 2015 to March 2016 are given in the following chart (source: www.gov.uk/government/statistics/solar-pv-cost-data).




No village-wide survey has been conducted either of the desire of individual residents to have solar PV installed, or the physical suitability of different properties. However, considerable interest was expressed in a village meeting in undertaking a coordinated programme of installations.

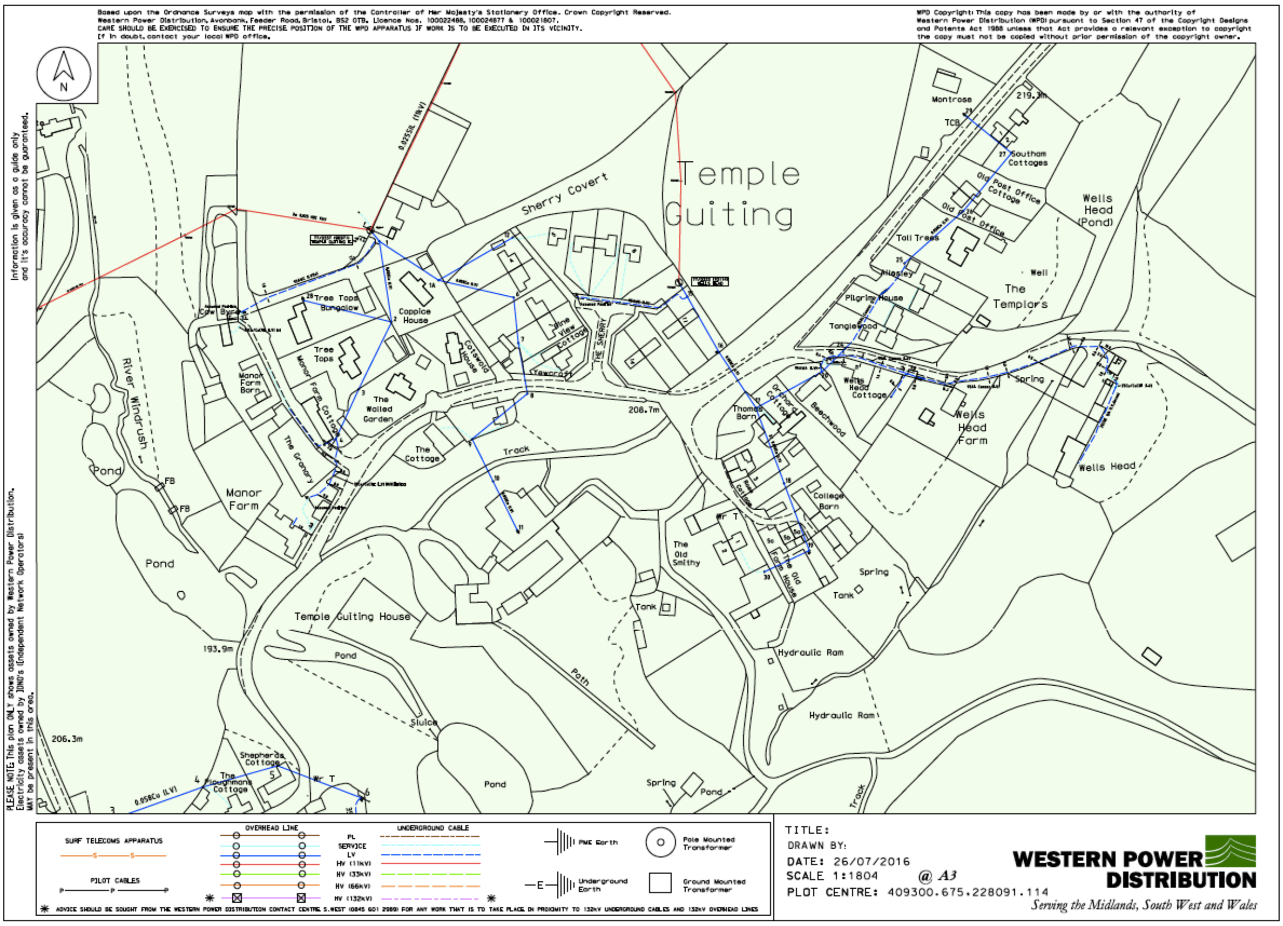
FIT rules mean that an individual householder is permitted to connect domestic-scale PV generation under the G-83 guidance (Engineering Recommendation G83 Issue 2 (August 2012) Recommendations for the Connection of Type Tested Small-scale Embedded Generators (Up to 16A per Phase) in Parallel with Low-Voltage Distribution Systems) (reference www.ofgem.gov.uk/ofgem-publications/52354/er-g83-2-v5-master-09-07-12-inc-ofgem-comments-clean-version.pdf). In short this means that PV panels must be limited to 3.6kW installed capacity (although in practice this is taken to mean around 4kW), and that, once installed, the householder (or FIT tariff provider) is required to inform the Distribution Network Operator (in this case WPD) that the installation has been made. No prior approval by the DNO is required.

In contrast, where a single supplier proposes to install multiple systems in the same area, either simultaneously or in succession over a limited period (eg if TGCE had sought to aggregate households together to achieve favourable terms and prices through a bulk installation), the FIT rules require the installer to seek prior approval from the DNO for the connections. The DNO has confirmed that the different circuits serving parts of the village have very little 'headroom' for more generation to be connected, and so the DNO may well have to refuse such a simultaneous multiple connection request, depending on exactly which properties wished to proceed, and with what amount of generation capacity.

This situation is clearly anomalous. Whilst the DNO may well not approve multiple simultaneous connections (nor any single connection greater than 16A per phase, or about 4kW), individual householders could nonetheless install PV systems without prior approval.

The DNO confirms that, if TGCE wishes to coordinate a simultaneous multiple-household PV installation, it will be necessary to submit a detailed map showing which properties wish to have generation, and specifying the amount of generation in each case. The DNO will then model the effect of this generation on the existing circuit, and determine whether, and how much, generation can be accepted.

The plan of circuits serving the main part of the village is shown here for reference:




## 8.3 Financial projections

A basic projection indicates a simple payback period of around 12 years for a householder, using the following assumptions:

- Property has an Energy Performance Certificate (EPC) of D or higher, meaning the highest FIT rate will be paid
- Installation in the period 1 January 2017 to 31 March 2017, securing FIT generation rate of 4.11p/kWh
- FIT export rate is 4.91p/kWh on deemed 50% of export
- Panels are optimally sited (due South and 30 degree pitch), and un-shaded
- Energy yield is 910kWh/kWp/year (output estimated from PVSYS for optimal orientation)
- Panels generate 3,640kWh/year
- Household electricity consumption is UK average of 3,300 kWh/year
- 50% of PV generation is consumed in the house, offsetting power purchased at 14p/kWh
- Installation price is lowest of median values recorded between 2015-16, at £1,500/kWp, making total installation cost £6,000 (but note this is at the most competitive end of the price spectrum)

Outputs:

- Annual financial value (generation tariff, export tariff and avoided electricity purchase): about £490
- Simple payback period: 12 years
- Notional net financial benefit over 20 years (not accounting for inflation): about £3,900 (ie, total 20 year 'earnings', less installation cost)

It is important to note the following:

- This projection assumes the house has the best case (ie, panel orientation and roof pitch, shading and EPC score). Any deviation from this best case will weaken the economic return.
- This projection does not take account of improvements over recent years in annual energy yield of PV systems, but note that systems with the best overall yield will also cost more, and so the simple payback period indicated here is likely to be broadly right.
- The amount of PV generation that can be consumed by the householder, and the rate the householder pays for electricity from their supplier, will significantly affect the economics.
- No allowance is made in this basic projection for replacement of any panels or inverters or other repairs made over the project life.

## 8.4 Planning and permitting

Temple Guiting village is in a Conservation Area. Whilst PV panels are still permitted development (subject to following basic guidance about positioning of panels on a roof), for houses that are not listed or sited in the grounds of a listed building, there are specific constraints created by the Conservation Area status as well as AONB status.

The most important of these is that, were the householder to choose to mount PV panels vertically on a wall, they would not be permitted to choose a wall that faces a roadway. It appears that the same rule does not apply for panels on a roof (either pitched or flat).

Panels not mounted on a roof (ie, mounted on the ground on suitable frames) are also permitted development, but only up to 9m2 (that is, about 1.5kWp capacity), and only as long as the panels are set back from any boundary not less than the minimum distance that the property is to the boundary.

A discussion has been held with Cotswold District Council planning department, which confirms that permitted development rights for PV panels exist within the Conservation Area, however the department is quite clear that any listed building would be unlikely to receive approval.

Any proposed PV panel installation in the village should seek approval from Cotswold District Council, and such permission should not be withheld as long as the permitted development guidelines are adhered to. TGCE should be aware, however, that there have been examples of householders in Conservation Areas having approval withheld or delayed, despite the national guidance on permitted development being in force. An early dialogue with Cotswold District Council is advised.

A copy of correspondence with Cotswold District Council planning department relating to village PV is in annex.

## 8.5 Site

Other than the planning issues above, it is important to note that the village has many mature trees, and that houses are in some places fairly densely sited. Furthermore a significant proportion of houses have stone tile roofs, and many houses are period properties which are likely to have solid stone walls, meaning they are likely to have poor EPC scores.

These factors will tend to reduce the viability of PV throughout the village. Non-optimal orientation will reduce annual energy yield, trees and adjacent housing could shade panels, stone tiles increases the cost of installation, and poor EPC scores means a lower FIT tariff. A property that had all these non-optimal characteristics would probably not be able to make PV pay for itself (ie, the simple payback period would be longer than the life of the panels).

# 9 Domestic scale electricity storage and related innovation

## 9.1 Summary

The technology of domestic scale battery storage of electricity, either to use PV generation when the sun isn't shining or to use cheaper off-peak electricity at other times, is not cost effective at present. Battery prices are coming down but will need to fall very significantly in order for the technology to make sense by itself. In the near future battery technology will be offered to householders alongside other enabling technology and conditions, such as smart metering, time of day tariffs etc. When that time comes TGCE could play a useful role in the community introducing and vetting offers from commercial providers. In the meantime, TGCE could seek to offer the village to bodies undertaking pre-market trials or pilot schemes.

## 9.2 Technology

This potential project is included for the following reasons:

- interest in the technology expressed by TGCE;
- the potential for the technology to enhance the economic return from domestic PV;
- the potential for the technology to facilitate greater penetration of renewable generation in the UK fuel mix
- the potential for the technology to provide greater return on investment once novel commercial models become mainstream

Domestic scale electricity storage in batteries is a very fast-moving area, with an intense focus worldwide on new technologies and new business models. There are UK manufacturers of batteries and related components, and a growing number of overseas companies introducing established technologies to the UK. Costs of this technology are expected to fall steeply over at least the next two or three years and probably much further into the future.

Batteries are sold to households to make better use of domestic PV (to store PV generation from the day to use at night), and in some instances to insulate the house from the inconvenience of power cuts.

Despite the intense interest in the technology, it generally does not make economic sense in the current environment, although we note that it is likely to become economic within the next two to three years given the expected continued cost reduction.

At domestic level the key technologies are lead-acid batteries and Lithium-ion batteries. Lead acid batteries are cheaper but have limited lifetime and are vulnerable to being discharged too deeply. Lithium-ion batteries are expensive but more efficient, longer lasting and capable of deeper discharge. Neither type is 100% efficient (so electrical energy is lost charging and discharging), and the performance of both will degrade over time.

No current battery technology is suitable to store electrical energy inter-seasonally (eg taking summer PV energy to use in the winter), which would be prohibitively expensive and take a huge volume of space. Batteries are generally used to smooth power consumption over 24 or possibly 48 hour periods.

In principle PV energy could be stored for later use the same day, and/or a household could use a time of day tariff (such as 'economy 7') and store cheaper nighttime electricity for use during the day. In the future it is likely that households will be able to use storage in conjunction with true variable tariffs for electricity supply, in which the cost of electricity varies throughout the day in response to the amount of instantaneous nationwide demand and generation, thereby increasing the savings and improving financial performance of the batteries.

## 9.3 Financial projections

Two domestic battery storage devices from different suppliers but with recent, and competitive, prices have been chosen for simple financial modeling:

Tesla Powerwall supplied by Joju solar with a usable capacity of 6.4kWh and an (estimated) total installed cost of £5k, and

BYD Lithium-ion battery with controller, supplied by Waxman energy including an (estimated, local) installation cost, with usable capacity of 2.5kWh and total installed cost of £1.8k.

**First business case: Storing 'economy 7' overnight electricity for use during the day.**

Assumptions:

- UK average electricity consumption: 3,300 kWh / annum
- Average daily electricity consumption: 9kWh
- Economy 7 overnight tariff rate: 6.3p/kWh
- Economy 7 daytime tariff rate: 12p/kWh
- Non-economy 7 all-day rate: 9.4p/kWh
- Each battery is fully charged with nighttime tariff electricity, with all stored electricity used the following day
- Remaining consumption is through daytime tariff

Results:

It must be noted that this is a crude model, which does not take account of the consumption of electricity in other appliances (eg night storage heaters, immersion heaters) during the cheap tariff period, and neither does it represent the UK average consumption of households with electric heating. Furthermore the model does not take account of battery system 'round trip' efficiency, which will significantly worsen the economic case here.

Nonetheless on this basis, the Tesla Powerwall stores and releases some 2,340kWh of nighttime tariff electricity per year, providing a cost saving of around £130 and giving a simple payback period of some 34 years and a simple return on capital of 2.9%. The BYD Lithium-ion battery pack stores and releases some 910kWh of nighttime tariff electricity per year, saving some £50 and giving a simple payback period of around 31 years and a simple return on capital of 3.2%.

Both payback periods are significantly longer than expected or warranted lifetimes of the batteries, so the batteries will not pay for themselves on this basis.

This suggests that battery storage to exploit economy 7 tariffs is presently un-economic, possibly except for specific cases such as households with heavy overnight electricity usage and the need for battery back-up for (eg) lighting circuits to protect against frequent power cuts.

A fall in cost by a factor of five (ie, 80% reduction) will make batteries economic for exploiting economy 7 tariffs.

**Second business case: Storing PV generation to use after sun-down**

The business case for storing PV electricity is much more complex, and demands a model that accounts for variation in solar output over the year. This can be simplified somewhat using a model with four summer months, four winter months and four 'shoulder' months. A detailed model would also account for how domestic electricity consumption varies per hour over the day and per month over the year, but in this model we have assumed flat consumption across the year.

**Assumptions:**

- Annual generation of a 4kW domestic PV installation: 4,000 kWh
- Average daily output of PV, four summer months: 20 kWh
- Average daily output of PV, four shoulder months: 10 kWh
- Average daily output of PV, four winter months: 3 kWh
- Average daily year-round household electricity consumption: 9 kWh

Making further assumptions about the fraction of PV generation which is used during the day in different parts of the year gives the following outputs for the amount of PV electricity stored and released each day, for the two battery sizes, at different times of the year:

- Average daily storage by a 6.4kWh battery, four summer months: 4.5 kWh
- Average daily storage by a 6.4kWh battery, four shoulder months: 5.4 kWh
- Average daily storage by a 6.4kWh battery, four winter months: 0.3 kWh
- Average daily storage by a 2.5kWh battery, four summer months: 2.5 kWh
- Average daily storage by a 2.5kWh battery, four shoulder months: 2.5 kWh
- Average daily storage by a 2.5kWh battery, four winter months: 0.3 kWh

With the larger battery, less energy is stored per day in the summer because more of the household consumption occurs when generation is happening. In the winter there is less unused PV generation to store.

**Results:**

In one year the Tesla Powerwall battery stores and releases PV generated electricity with an equivalent value of around £120, giving a payback period in excess of 40 years and a simple return on capital of around 2%.

In one year the BYD Lithium-ion battery stores and releases PV generated electricity with an equivalent value of around £60, giving a simple payback period of around 30 years and a simple return on capital of around 3%.

In each case, the payback period is substantially longer than the warranted life of the battery, meaning that the storage systems cannot pay for themselves. A fall in battery capital cost of a factor of five (ie 80% reduction) would be required before these systems become cost effective.

It is essential to note that these calculations are necessarily very approximate, and a proper understanding of the behaviour of domestic-scale batteries linked to PV generation is required in order to have full confidence in the numbers.

## 9.4 Future developments, innovation and recommended next steps

TGCE should not in the short term promote domestic-scale battery storage, given its poor economics.

However it is likely that within two or three years, the cost of domestic scale storage may have fallen to the point where the community energy company could aggregate together many properties in the village and create a genuinely $CO_2$-saving and cost-saving proposition.

Innovation in battery storage will soon extend beyond the batteries themselves, to include control, smart metering and integration with variable time of day tariffs. These changes are likely to improve economic performance compared to the very simple business cases given above.

We recommend that TGCE keeps a watching brief on domestic scale batteries, and re-runs simple financial evaluations as prices fall and more products come to market. TGCE could act to aggregate the interests of several households in the village and invite battery technology providers to present to the village as a whole. This would also be a good way of TGCE fulfilling its mission to keep villagers up to date with green energy innovations.

**Village-scale storage trials**

Research and commercial trials centred on electricity storage will continue to be important in the next few years, given the worldwide focus on this technology and the rapid evolution of new technology and regulation / policy governing this growing area. New commercial models to support storage are continuously being developed by supply companies and battery manufacturers, and often have the active participation of distribution companies. In a very fast-moving field where pilot projects are being developed, there is a need for communities willing to host trials. In this instance, costs to trial participants are likely to be low or zero, in return for providing a 'host' site for batteries and other equipment, and allowing detailed remote monitoring of the performance of the equipment.

We recommend that TGCE seeks opportunities to take part in storage innovation trials, representing a good storage 'test bed' village with weak and inflexible grid connection. Such trials, whilst only obliquely supporting renewable electricity generation, may be capable of generating revenue and thereby strengthening the community energy company. Bringing individual households into such a trial would act as very good publicity for TGCE and provide a focal point to raise awareness and increase understanding locally about energy. In turn, this should increase confidence in TGCE for investment into new renewable generation projects.

**Expanding storage trials to innovative electricity supply arrangements**

The 'holy grail' of local renewables, certainly from the perspective of community energy company investors, is to link generation directly to household consumption, thereby simultaneously reducing the cost of electricity for the household (possibly a community energy investor) and increasing the value of generated electricity for the project.

The present electricity industry structure, charging arrangements and policy related to generation, transmission, distribution, supply and metering means this is not currently possible outside small scale, highly innovative trials which are 'pushing the boundary' of what is possible within existing policy and regulation.

Such trials have to involve licensed electricity suppliers and have the purpose of testing new approaches and technologies and stimulating those changes necessary to revolutionise the electricity industry, and deliver a future in which distributed intermittent generation, local storage, DC networks, intelligent control and load management, demand side management, dynamic time-of-day pricing and other innovations act together to provide low carbon, reliable and cost effective energy.

Examples of innovative trials can be seen in the 'sunshine tariff' in Wadebridge in Cornwall (supported by multiple actors including WPD), the work of Energy Local (see http://www.energylocal.co.uk), and government-supported trials such as the 2013 energy storage trial using Moixa Technology batteries (see www.meetmaslow.com/wp-content/uploads/2015/07/Moixa-Technology-DECC-Project-summary.pdf). Such trials seek to link generation and consumption in a local area, and are likely to increase the economic value of storage. Mongoose Energy's supply offering aims to provide similar economic links between community-owned generation and local consumption.

We recommend that TGCE actively seeks opportunities to participate in future trials of innovative schemes requiring the active participation of households in a concentrated geography.

**Supply aggregation**

A further whole-village, or multiple-household, initiative that only obliquely supports renewable generation but would strengthen TGCE, would be for TGCE to broker group switching to a new electricity supplier, in such a way that TGCE receives a payment for each customer that switches, and a further loyalty payment for each year that the customer stays with the supplier. Whilst switching payments will be modest (of the order of £20-£30 per customer per year), it would have the potential to create some momentum and revenue for TGCE, a small contribution to the community fund, provide a focus for villagers to engage with the company (and save money on energy bills, depending on their current supply arrangements), potentially create a link to generation projects such as Farm Park PV, and also provide a focus for village engagement in initiatives to save energy / $CO_2$.

# 10 Roof- or ground-mounted PV on the church and school

## 10.1 Summary

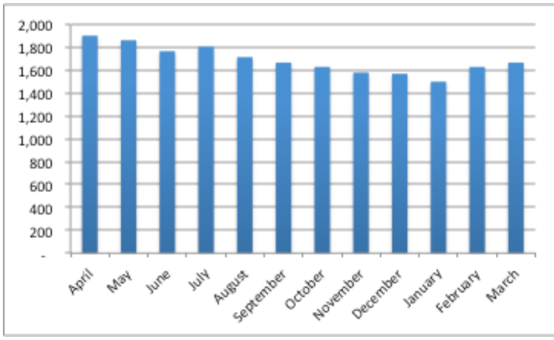
The school and church are both supplied from the same circuit, which has a severe capacity constraint, meaning that the church is likely to be limited to a 3.6kW (domestic scale) installation, whilst the school could potentially connect up to 10kW (on the assumption that the school is three-phase connected).

## 10.2 Technology

Small scale roof mounted or ground mounted PV technology is well established and does not need further description here.

As stated in section 9, prices have been falling and broadly continue to fall, but the rate of installation has dropped following a severe reduction in the Feed-in Tariff, and this will tend to slow the rate of price reduction.  Over the medium term, prices of panels and inverters are expected to fall further but certain aspects of the whole installation price (eg the cost of a team of installers, transport, scaffolding, electrician) will not fall at the same rate, if at all.

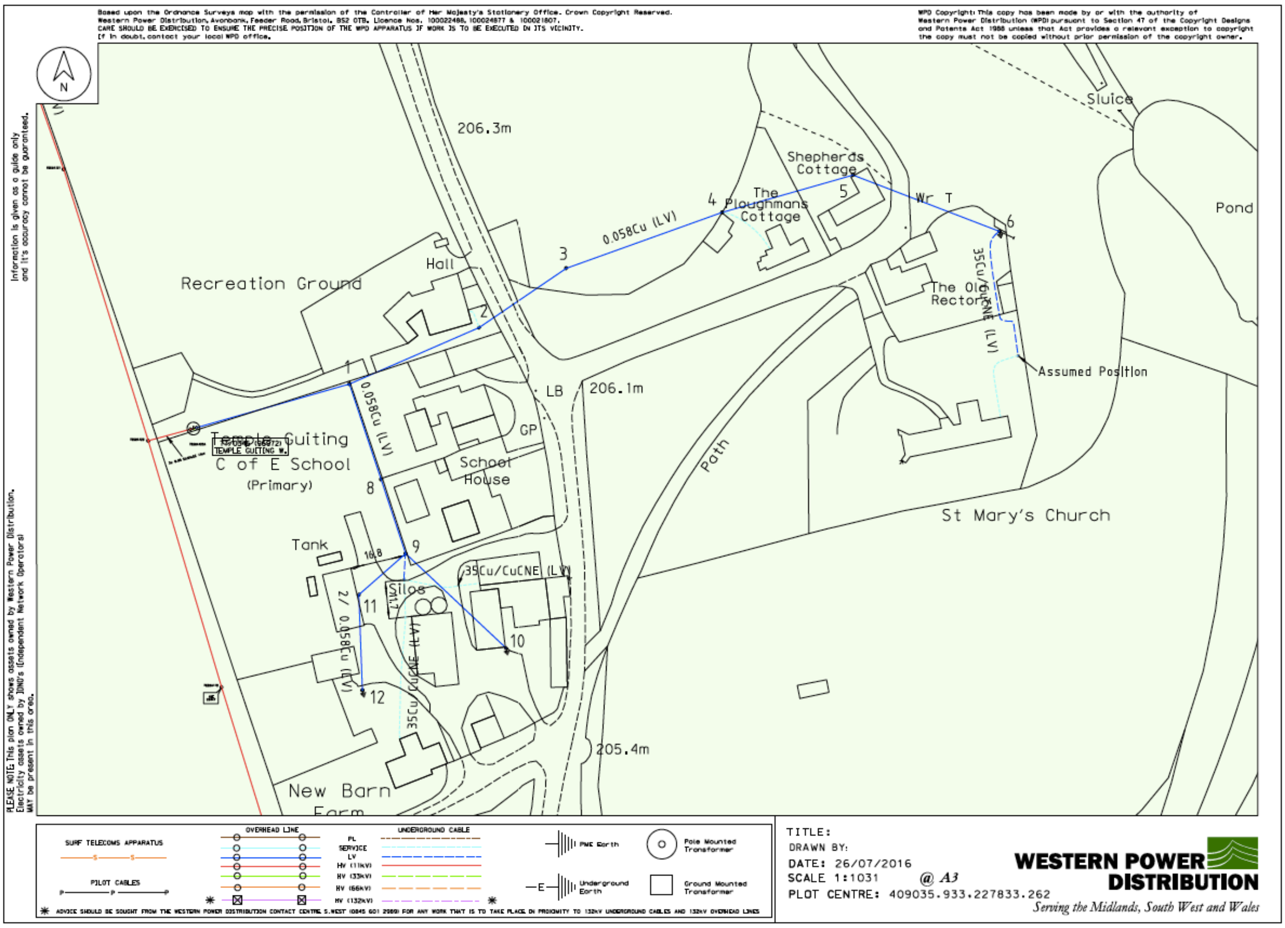
The fall in cost per kW installed (systems <4kW) from April 2015 to March 2016 are given in the following chart (source: www.gov.uk/government/statistics/solar-pv-cost-data).




The key issue for the church and school is the capacity of the electricity supply to each property, and the limit this puts on the amount of generation that can be connected.

The school and church are both supplied from the same circuit, which has a severe capacity constraint, meaning that the church is likely to be limited to a 3.6kW (domestic scale) installation, whilst the school could potentially connect up to 10kW.

The plan showing WPD's infrastructure local to the school and church is given here for reference:




If the church individually, or through TGCE, wishes to install up to 3.6kW of PV generation it may do this under the G83 connection guidance, and inform the DNO after the event.

If the school wished to connect more than 3.6kW then TGCE would need to seek permission from WPD. WPD has indicated that up to 10kW is likely to be possible, on the assumption that the school is 3-phase connected. If the school is single phase connected, the limit of PV generation size may be smaller.

## 10.3 Financial projections

Financial projections for the school and church will be broadly similar to the individual household projections (with payback of around 12 years in optimal conditions).

However, there are specific conditions for both the school and church which will tend to reduce the benefit of the scheme and make payback poorer:

The school has a good supply-demand match: during the day when solar output is highest, the school will be occupied and all the PV power generation (depending on size) is likely to be used, so off-setting grid electricity cost. However, the school is un-occupied for weekends and holidays, and the summer holiday particularly (corresponding with peak annual PV output) means that much less PV power will be used on-site than would be the case with, for example, a commercial premises occupied throughout the year.

The church has a poor supply-demand match: there is likely to be limited demand for power during the day when PV output is greatest, and therefore less mains electricity will be displaced, thus lowering significantly the financial benefit received.

Without knowing the exact annual consumption and time profile of that consumption for the church and school financial modeling will be potentially misleading. However for the reasons given above, and for site-specific reasons explained below, the payback periods for each are likely to be poor, and potentially in the region of 15 years.

## 10.4 Planning and permitting

The school faces the same Conservation Area issues as the rest of the village, described in section 9 above.

The Church of St Mary is grade I listed, and as such is highly likely to face severe planning difficulty, whether solar panels were proposed for the church roof itself, or within the curtilage of the building.

In respect of permission under the Feed In Tariff regulations, it should be noted that schools and community groups receive particular treatment (refer to https://www.ofgem.gov.uk/system/files/docs/2016/04/fit_community_and_schools_guidance_v3.pdf) . The value of this special treatment is limited, but may be useful for the school if it has a non-domestic Energy Performance Certificate (EPC) between G (the lowest) and E. Given the school's age and construction it is possible that its EPC is poorer than D (the normal cut-off for award of the highest FIT rate), and therefore registering an installation under the school and community conditions will be important.

## 10.5 Site

The school appears to have a roof-mounted opportunity, with a hypothetical 10-12kW identified in the Google Earth view below, on an approximate E-W orientation. Shading from trees or adjacent roofs appears minimal. However, we note that the school roof appears to be stone tiled, meaning that installation will be more expensive, or potentially infeasible. Ground mounted panels are a possibility, but we note the pressure on playground space round the buildings, and the potential for concern about child safety and/or vulnerability to damage if panels were ground-mounted in the school grounds.

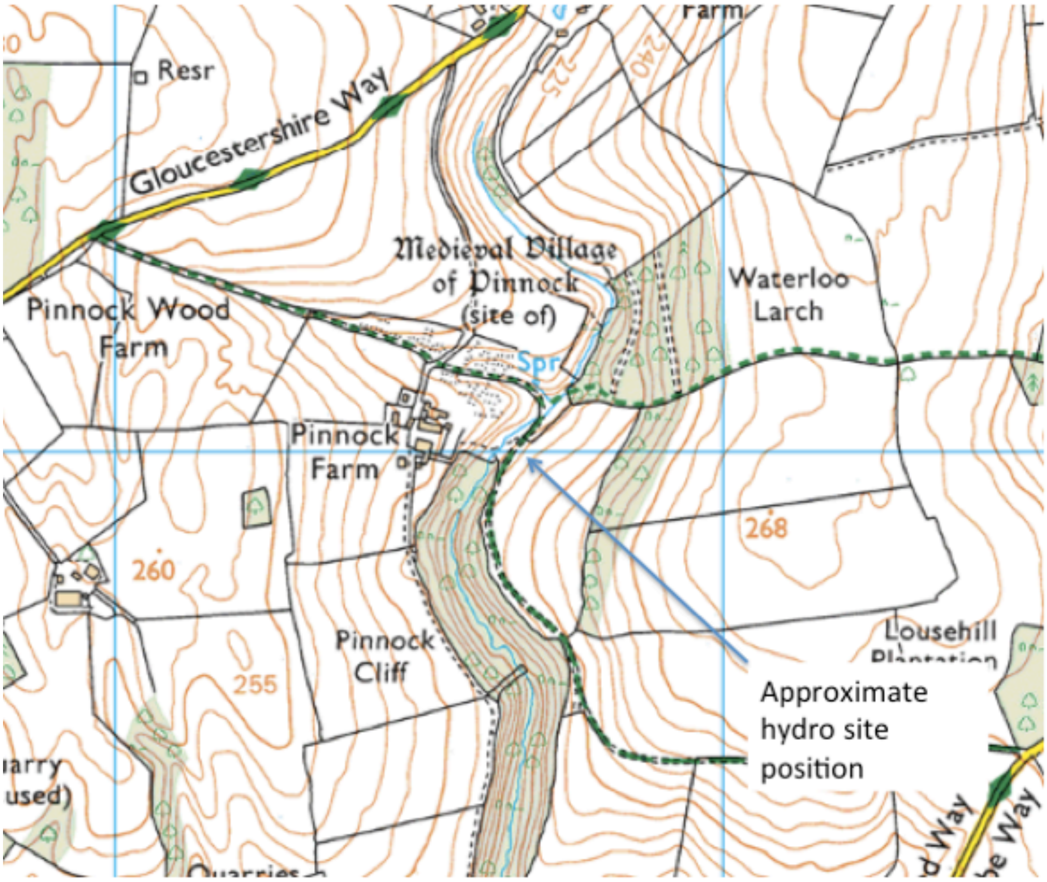

The church site potentially has up to 5kWp capacity on the main roof, but we note the severe planning difficulty already mentioned, and furthermore the age of the roof means the cost of a structural assessment will be high and the roof may not be suitable for installation of panels. The sole point in favour of the church roof is the potential for the array to be hidden from ground view by the pediment. Nonetheless, simply arranging inverter siting and cabling in a way that is acceptable in a grade 1 listed church is likely to be challenging.

# 11 Small scale hydro

## 11.1 Summary

The potential hydro scheme located close to Pinnock Farm appears too small to be economic. We recommend no further action is taken.

## 11.2 Technology




Small scale, run-of-river hydro technology is well established. Turbine choice is largely driven by head, where there is disagreement about the exact definitions of low and high head, but the Pinnock Farm hydro, at around 5m head, would be classified as low head. Various turbine options exist for low head sites such as this.

No on-site use for power or heat exists, and so the power would need to be exported to the grid.

Early discussions with Severn Trent Water indicated that the company would be willing to facilitate the connection of a generator to the electricity grid, at a water pumping station some 500m or so from the generator site. The cost of cabling back to the point of connection may itself be prohibitive, since it may be necessary to transform the AC power up to 400V or similar, and then back to a voltage level appropriate for the transformer at the point of connection. This will drive up costs and increase electricity losses.

The key issue for the hydro scheme is the amount of energy available, which drives the economics. Following on-site very approximate measurements of head and flow, we conclude that the head is of the order of 5m, and the flow at the time of measurement approximately 50l/s or less. People familiar with the site state that the flow does not vary greatly over the year, which is consistent with the spring-fed nature of the site.

## 11.3 Financial projections

Only very simple financial projections have been made, considering the small size of the scheme.

**Assumptions:**

Head: 5m

Flow rate: 50l/s (0.05m3/s)

Total system efficiency: 50% (water potential energy to electrical output energy)

Load factor: 95%

FIT generation tariff: £0.076/kWh

FIT export tariff: £0.0491/kWh

Annual Operations and Maintenance cost: £600

Capital cost of installation: £ varies

**Results:**

Electrical output power: 1.1kW

Gross annual revenue from electricity sales: £950

Net annual revenue: £350 (annual revenue less O&M cost)

Simple payback period with a £10,000 total capex: 29 years

Simple payback period with a £20,000 total capex: 58 years

We acknowledge there are significant uncertainties in these costings, but we would make the following observations:

- Hydro schemes are notorious for the length of time taken to achieve construction – planning permission and EA approvals can take years. An extended project development period can only add to the development cost and make the scheme more un-economic.
- Hydro schemes have considerable uncertainty in cost, and have a high probability of cost overrun, particularly in relation to civil engineering works. In this case it is not clear to what extent the existing civils could be used. Any significant repair or upgrade to civil engineering works at the site would push the capex higher and make the scheme unworkable.
- Even if every cost came in at the bottom end of the range of estimates, the hydro scheme would still generate a very small financial return relative to the amount of effort and time that TGCE would need to devote in order to build the scheme.

For these reasons we recommend that the hydro scheme is not taken forward.

# 12 Operation and Governance

Given the relatively early stage of the group, operation and governance are necessarily weak at this stage, and therefore the most important focus for the group in the short term is to put in place a balanced and capable team that can carry projects forward.

The legal entity for Temple Guiting Community Energy (TGCE) has not been decided but is likely to be a Community Benefit Society or Community Interest Company. This decision will have to be taken in the light of expected fundraising needs.

Given the small size of projects foreseen, debt funding is unlikely to be viable. Therefore the legal structure will probably reflect the need for funding to come from local equity (membership) through a share issue.

Governance of the community energy company, when formed, is likely to be straightforward as long as existing or previous members of the Parish Council can bring experience of running organisations. However all executives or non executive directors of the new company will need to embrace commercial timescales for decision making and company management.

The anchor person and a key driving force in the group is Robert Llewellyn who is perfectly placed to continue to provide impassioned and enthusiastic leadership. Robert claims not to be an expert in renewable energy and related technology, but has a solid broad understanding through his extensive contact with experts and his broadcast and other media assignments in this technical area (renewables, electric vehicles, battery storage and related topics). His professional commitments mean he may not always be available for the group with the regularity that is likely to be required particularly in bringing the Farm Park project forwards.

Other key candidates for the leadership / working group are still to be established, but there are certainly relevant skills and significant experience among those attending meetings to date.

It will be essential to assemble a core team who between them have project management, accounting / finance skills, and commercial / negotiation skills. The group may have to rely on external expertise for contractor selection and other technical aspects of the Farm Park project, although Robert's strong general background will be important here.

Succession plans have not been considered to date.

# 13 Conclusions

Temple Guiting Community Energy has considerable strengths, in the enthusiasm of those leading the way, the sustained interest in community-led renewable energy project development and investment, the socially cohesive nature of the village with a critical mass of people interested to take these initiatives forward, and the high likelihood of local residents being able to raise investment sums through membership of a community energy company, without resorting to debt.

The key challenge for TGCE is in the number and scale of viable investment prospects. The project that has the highest prospect of success in the near term, and is essential to achieve, is roof-mounted PV on the Cotswold Farm Park. This project, with a capex of around £50k, project IRR of around 6% and community fund value of around £6k, is the only medium term project that appears viable. However once TGCE is established and this project is underway, the group will be better placed to explore other opportunities.

The school (10kW roof-mounted PV) appears feasible in principle but project returns are likely to be poor due to a lack of on-site consumption in school holidays and weekends. There are significant unknowns that may increase cost (roof structure, access), and for this reason it should be a second order priority.

Given a very limited number of small projects, the group must accept the inherent higher risk that comes from being unable to spread risk among many projects, and may need to propose to members a rate of return on investment that is less than other community groups have achieved in the past.

A significant challenge, and a priority, for the group is to assemble a core team of individuals with the right mix of skills and experience who can push the Farm Park project forwards at speed, with an early action being the establishment of TGCE as a Community Benefit Society or similar structure. A core group already exists, and given the evident enthusiasm of the group it should be successful.

# 14 Annexes

## 14.1 Annex 1: Correspondence with Cotswold District Council planning department:

**From:** Christopher Crookall-Fallon [mailto:chris.crookall-fallon@mongooseenergy.coop] **Sent:** 27 July 2016 16:11 **To:** Planning mail **Subject:** Clarification re: Conservation Area status (Temple Guiting) and ground-mounted solar panels and other renewable energy technologies

Dear planning department

I'm undertaking a high level study for Temple Guiting Parish Council, looking at the technical and economic feasibility of small scale renewable energy generation in and around the village, with a view to locals forming a small community-owned renewable energy company.

I'd like to have your comment / clarification of a couple of aspects of these ideas please:

1) Question on *proximity* to a Conservation Area. The recently published (June 2016) Cotswold District Local Plan 2011-2031, Submission Draft Reg.19, contains Policy INF10, relating to Renewable and Low Carbon Energy Development. The policy refers to the mitigation of adverse impacts (visual, landscape, heritage, biodiversity, highways, residential amenity). Can you advise me whether the interpretation of adverse impacts would be any stricter, or different in any way, if proposals were put forward for ground-mounted solar PV arrays or small scale wind turbines outside but within the vicinity of the Temple Guiting Conservation Area? To put the question in other words - does *proximity* to a Conservation Area affect planners' view of adverse impact, or is the only relevant question whether the proposed scheme is within or outside the Conservation Area?

2) Question on development *within* a Conservation Area. Some interest has been expressed in siting ground-mounted solar PV panels in gardens within the boundary of the Temple Guiting Conservation Area. Guidance from the planning portal (https://www.planningportal.co.uk/info/200130/common_projects/51/solar_panels/3) suggests that ground-mounted PV panels up to nine square metres are treated as 'permitted development' but in a Conservation Area, "no part of the solar installation should be nearer to any highway bounding the house than the part of the house that is nearest to that highway." Are there any other restrictions, or any different interpretation of this solar panel rule, that pertain either to Conservation Areas in general within the Cotswolds AONB or within Cotswold DC's area, or to Temple Guiting Conservation Area specifically?

3) Question on development within the boundary of a listed building. The Planning Portal is clear that solar panels may not be fixed to a listed building or to a building within the grounds of a listed building or scheduled monument. Can you tell me whether any particular rules relate to the siting of stand-alone ground-mounted solar panels in the grounds of listed buildings, and specifically whether 'permitted development' rights exist for such developments, or would each development have to apply for planning permission for such an installation? (ie, and installation at or below the permitted development size of 9 square metres).

With many thanks for your help

Chris Crookall-Fallon

01/08/2016
Dear Mr Crookall-Fallon,

Thank you for your enquiry.

Temple Guiting (and the area around it) is located within the Cotswolds Area of Outstanding Natural Beauty (AONB). The Council has a statutory duty to have regard to the purpose of conserving or enhancing the natural beauty of the landscape.

Paragraph 17 of the National Planning Policy Framework (NPPF) states that planning should recognise 'the intrinsic character and beauty of the countryside'

Paragraph 109 states that the planning system should contribute to and enhance the natural and local environment by 'protecting and enhancing valued landscapes'.

Paragraph 115 states that 'great weight should be given to conserving landscape and scenic beauty in ... Areas of Outstanding Natural Beauty.'

Local Plan Policy 42 advises that ' Development should be environmentally sustainable and designed in a manner that respects the character, appearance and local distinctiveness of Cotswold District with regard to style, setting, harmony, street scene, proportion, simplicity, materials and craftsmanship'

With regard to heritage assets the following is relevant;

Section 66(1) of the Planning (Listed Building and Conservation Areas) Act 1990 states that when considering whether to grant planning permission for development which affects a listed building or its setting, the Local Planning Authority shall have special regard to the desirability of preserving the building or its setting or any features of special architectural or historic interest which it possesses.

With respect to any buildings or other land in a conservation area Section 72(1) of the aforementioned legislation states that special attention shall be paid to the desirability of preserving or enhancing the character or appearance of that area.

Paragraph 132 of the NPPF states that 'when considering the impact of a proposed development on the significance of a designated heritage asset, great weight should be given to the asset's conservation. The more important the asset, the greater the weight should be. Significance can be harmed or lost through alteration or destruction of the heritage asset or development within its setting.'

Paragraph 134 states that 'where a development proposal will lead to less than substantial harm to the significance of a designated heritage asset, this harm should be weighed against the public benefits of the proposal, including securing its optimum viable use.'

Paragraph 009 of the Planning Practice Guidance (PPG) states that 'heritage assets may be affected by direct physical change or by change in their setting. '

Paragraph 013 of the PPG states 'Setting is the surroundings in which an asset is experienced, and may therefore be more extensive than its curtilage. All heritage assets have a setting, irrespective of the form in which they survive and whether they are designated or not.'

Cotswold District Local Plan Policy 15 states that construction 'within or affecting a Conservation

Area must preserve or enhance the character or appearance of the area as a whole, or any part of the designated area.'

Paragraph 2 of Policy 15 states that development will be permitted unless;

(a) They result in the demolition or partial demolition of a wall, structure or building, or the replacement of doors, windows or roofing materials, which make a positive contribution to the character or appearance of the Area;
(b) the siting, scale, form, proportions, design, colour and materials of any new or altered buildings, are out of keeping with the special character or appearance of the Conservation Area in general, or the particular location; or
(c) they would result in the loss of open spaces, including garden areas and village greens, which by their openness make a valuable contribution to the character or appearance, or allow important views into or out of the Conservation Area.

The Council would have to have regard to all of the above when considering applications for development within the AONB or affecting the setting of heritage assets such as Listed Buildings or Conservation Areas. The draft policies in the emerging Local Plan are still at a consultation stage and therefore carry minimal weight at the present time.

An application could therefore be refused if it affected the setting of an LB or CA.

Further guidance on permitted development rights insofar as domestic and non domestic solar panels are concerned can be found at:

https://www.planningportal.co.uk/info/200125/do_you_need_permission

If the proposed development meets the criteria stated in the above link then planning permission would not be required. If panels are to be attached to a Listed Building then Listed Building Consent will be required even if planning permission is not. All the criteria covering solar panels are set out in the above link.

Planning permission is required for the installation of any stand along solar panels within the curtilage of a Listed Building.

I trust this information is of assistance.

*Martin Perks*
*Senior Planning Officer*

*Tel: 01285 623082*

## 9. Scheduling

Have you considered the scheduling of the project, including the meeting of project milestones such as delivery of technical reports, the gaining of planning, gaining of permits, identification of contractors, start of construction phase, etc?

## 10. Conclusions

Following the feasibility study, what is the likelihood of the community successfully developing this project through to completion – i.e. a fully operational renewable energy installation?

[strong likelihood as long as the community can access technical and financial support at key phases in the project development]